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1939, No. 2 July 12

Observations on the Breeding Habits of the Cut-lips Minnow, *Exoglossum maxillingua* [1]

By Evelyn M. Van Duzer

Introduction

THE cut-lips minnow, *Exoglossum maxillingua* (LeSueur), has been known as a nest builder for some time. There is, however, a lack of information on breeding habits in the literature. The only contributions are those of Hankinson (1922) and Greeley (1927 and 1930). These reports, covering observations made on four days only, were extremely helpful in initiating this study. The observations recorded here were made within a radius of 30 miles of Ithaca, N.Y., largely in the Susquehanna drainage.

Habitat and Associates

Cope (1869: 359) covers the observations of most writers when he says of this fish: "In its movements it is sluggish. It keeps near the bottom in pools and channels of our clear rocky streams, not preferring rapids." I have found the species distinctly one of the bottom and generally more sluggish than the other minnows with which it is associated. The five streams studied offer similar habitats: clear water with moderate to moderately swift current, quiet pools from 2 to 4 feet deep, a firm rubble bottom with many large flat rocks and an abundance of gravel. Large flat rocks seem to be a very important factor. This is especially evident during the breeding season and in winter. In making winter collections, I have netted from eight to twelve cut-lips at one time from under one large rock, while I was able to collect it scatteringly or not at all from pools and open water. I found summer collecting best in pools. Disturbance of large rocks yielded this species, but not as consistently nor in as large numbers as in winter collecting.

The most closely associated form was found to be the madtom, *Schilbeodes insignis*. This association was especially marked during the winter when both forms were taken in numbers from under the same rock or log. Frequently collecting in this way yielded only the two species. This gregarious habit is much more pronounced with the madtom, however, and it is taken in larger numbers in a single haul than the cut-lips. Other forms which I have found most commonly associated are: common shiner, *Notropis cornutus cornutus;* horned dace, *Semotilus atromaculatus atromaculatus;* johnny darter, *Boleosoma nigrum olmstedi;* common sucker, *Catostomus commersonii commersonii;* and black-nosed dace, *Rhinichthys atratulus atratulus*.

Spawning Habitat

The study of breeding activities was carried on in the South Branch of Catatonk Creek (Susquehanna drainage) near Candor, New York. Detailed observations were made throughout the season in 1500 feet of this stream near its mouth. The width, in this section, was mainly between 15 and 35 feet. The depth of water in the channel during the early part of the season varied at different points between 1 and 3 feet. Late in the season, following two weeks of little rain, the deepest part carried but 1½ feet of water. The current is moderate, the surface smooth and the water clear. Most of the section

[1] M.S. thesis, Cornell University, 1931–32, under direction of Albert Hazen Wright and E. Laurence Palmer.

has a firm rubble bottom with an abundance of gravel and many large flat rocks. The stream bed is somewhat cluttered with submerged logs. The bottom in most areas is covered by a thin layer of silt and some algal growth.

No nests had been observed here prior to May 15. On May 22 nest building was well started. Fifteen partially constructed nests were located that day. By June 1, a total of thirty-six nests had been started. By June 11, forty-six additional nests had appeared. From June 11 to July 11, twelve new nests were built at increasingly longer intervals, making a total of ninety-four nests in the area during the season.

Location of Nests

Nests were always constructed where the current was sufficiently strong to insure a constant change of water. No site, even though otherwise ideal, was used where vegetation or excessive detritus impeded the flow. The most favored location seemed to be under or very near one of the submerged logs on the stream bed. Every site of this type which presented sufficient flow was occupied early in the season.

Most mid-season nests, the largest group of the season, were between, near or partly under large flat rocks and smaller pieces of submerged wood. Four were built in runways cut by the stream in the clay near the bank. Three of the twelve late season nests were constructed entirely under large flat rocks elevated on the upstream side. The remainder of the late season nests lacked the usual protection offered by rocks or wooden objects.

In one section nearly 300 feet long no nests were built. Here the stream had widened abruptly to 40 feet and more. The current was very sluggish and vegetation was abundant well out from shore. The bottom, where firm, was very heavily silted and there were but few large flat rocks.

The depth of water in which nests were constructed varied considerably. Some early season nests were built in 2½ feet of water. Later, with the water level 1½ feet lower, not more than 3½ inches flowed over several nests in use.

Early and mid-season nests were located near the center and along the edges of the stream in almost equal numbers. All very late season nests were, as might be expected with the water level much lower, in the channel of the stream.

Building the Nest

At nests built early in the season in deeper water, activities were undisturbed by observers. It was even possible to move about or take an occasional handful of stones from the nest without apparent disruption. Neither was activity affected by rain, in which observation was still possible. In contrast, at those nests built in shallow water later in the season, observation could be made only at a distance and then with difficulty. Any fish present at a nest were extremely wary and left at the approach of an observer, often to remain away for some time.

As Greeley (1930: 81) describes, the nest was constructed by a lone male. Pebbles were collected from the stream bed and transported in the mouth to the chosen site. Great care was exhibited in selection of stones. Frequently several were rejected before one was seized. Usually but one stone was carried, occasionally two, a small one in the mouth and a larger one projecting from the jaws as usual. The number of stones brought to the nest per minute

did not ordinarily exceed six. At the peak of this activity, stones were sometimes collected at the rate of ten per minute. The distance covered in one trip varied most frequently between 1 and 10 feet, but trips up to 20 feet were not uncommon. No preference in direction was exhibited. Usually several trips were made to the same location, and frequently collecting in the same area continued for a considerable period. This fact probably explains Hankinson's suggestion of an upstream preference since his observations were made on one day only. Collections at random were equally common, especially where the supply of suitable stones was abundant. There was no evidence of restriction to individual collecting territory. Nests were sometimes built very close to each other and males worked in the same collecting area without apparent notice of each other. In these congested areas, males were observed stealing stones in considerable numbers from nearby nests. This was possible only in the absence of the owner, however, as the nest itself was vigorously guarded throughout the season.

Time of Building

Building was never observed before 8:55 A.M. Most frequently it began slightly later. It started in a sluggish and spasmodic manner, developed gradually into rapid and regular work, and decreased as gradually toward the end of the day. These three periods, while not easily separated, fall roughly within the hours (1) 9:00 to 11:00 A.M., (2) 11:00 A.M. to 5 P.M., and (3) 5:00 to 7:00 P.M. On certain days which for some reason were characterized throughout by little work, irregularly done, beginning was delayed until 10:20 or later. On other days marked by unusual activity at all nests, the second period was reached earlier (10:00 to 10:30 A.M.) and the beginning of the decline apparent later in the day (6:30 to 7:00 P.M.). Two individuals were observed working slowly as late as 8:30 P.M. During the late evening, night and early morning hours, the males were found motionless, on their nests or under some nearby shelter. The major portion of the nest is constructed before breeding begins, but building continues throughout the breeding period and is intimately connected with it.

Length of the Building Period

The longest building periods occurred in the early part of the season. These early nests were large, well placed and carefully constructed. At two nests discovered on May 22, from one-fourth to one-third finished, building went on at a rapid rate for three more days before breeding was observed, and continued until June 6.

On June 1 at 4 P.M., a nest barely started was discovered. At this time less than seventy-five stones had been placed. On June 2 at 4:30 P.M., it measured 5 inches in width and 2 inches in height at the crest. At 4:00 P.M. on June 4, when breeding was first observed, the nest was 12 inches wide and 4 inches deep. Very little building was observed at this nest after June 6, although the male was seen near the nest during the day until June 14.

As the season progressed, increasingly less time was spent in nest building. Late in the season nests started one day were frequently used for spawning the next. Breeding was observed on June 29 from 3:30 to 4:30 P.M. at a small nest which had not been evident on June 28.

By the simple expedient of seizing a nest already constructed, some males apparently found it unnecessary to build at all. Twice during the season there was a sudden influx of males, evidently ready to breed. Smaller males were then driven from their nests, where breeding had already occurred. Frequently the new male began breeding immediately without additional building. In one instance, but ten minutes elapsed after he had taken possession. The dispossessed males usually remained in the vicinity from two to four days, making frequent attempts to recapture their nests. They were occasionally observed to breed there in the absence of the larger males. One of the nests discovered on May 22 was evidently on a particularly desirable site, and from June 3 to 6, possession was disputed by the original owner and two larger males. Building was done at different times by all three claimants. This was most difficult for the smaller original owner, which frequently circled the nest several times in a frantic attempt to place a stone, only to drop it 6 or 8 inches from the nest and then repeat the attempt with another stone from the stream bed. All disputed nests, with one exception, came into possession of the largest male.

Three males were observed to construct what I have chosen to call an "afternest." These were smaller than the original and close to it. No eggs were ever found in them. This occurred at one of the nests discovered partly constructed on May 22. The "afternest" was begun June 11, before the original nest was empty. After the fry had left the nest, the male, though seldom evident during the day, could be found on the smaller pile at night until June 17. The behavior of the other two males was similar.

Materials and Appearance

Such wide variation existed in every aspect of nest building that it is difficult to describe any as typical. With one exception all the nests were built with a gentle upstream slope which occupied the greater portion of the surface of the nest. This was banked more steeply on the downstream side, evidently as a support for the upstream area where breeding occurred. When the nest was built against some heavy object in the stream, this more abrupt downstream slope was not apparent. The majority were, as Hankinson states (1922: 2), "roughly circular." Occasionally where the surroundings were limiting, nests were built in the form of a shallow rectangle. One was distinctly triangular. Most of the nests presented a relatively flat appearance such as dimensions 18 inches wide by 5 inches high, or 12 inches by 3 inches, might suggest. A few were more mound-like, with measurements typically 12 by 6½ inches.

Stones in individual nests appeared to be strikingly uniform in size. Close examination showed this to be true of most of the nesting material. However, a few much larger and many considerably smaller than average were included. Most of the pebbles were flat with angular margins or thin edges. These factors would seem to determine more than roughness or smoothness, the suitability of stones and to account for the conduct of the male in selection. Smooth stones were found as commonly as rough ones.

The average size of stones was found to be directly proportional to the size of the building male. This is undoubtedly controlled by the size of the

mouth in different stages of growth. An interesting illustration of this point developed where two small logs formed an X lying across the center of the stream bed. Here three males constructed adjacent nests. On the upstream side in front of the point of intersection of the logs, a large male (5¼ inches) built a nest 15 inches wide and 4½ inches deep at the crest, of stones measuring for the most part ½ to ¾ of an inch in their greatest diameter. Under one downstream arm of the X, and in contact with the first nest, a male 4 inches in length constructed a nest 10 inches wide and 3 inches deep, of pebbles measuring mostly under ½ inch in their greatest diameter. Under the other downstream arm a 3 inch male, the smallest of the season, built a nest 5 inches wide and 1 inch deep, of pebbles measuring ¼ inch and under. Less extreme variations were observed in other parts of the stream.

The vast majority of nests were constructed by males 4 to 5½ inches in length and their nests were made for the most part of stones measuring from ½ to ¾ of an inch, thus presenting a generally characteristic appearance.

The measurements of the three above-mentioned nests indicate that the size of the nest, as well as that of the stones, varied with the size of the male. Within definite periods in the breeding season, this was apparently true, though not always so. A much more important factor in size variation seemed to be the period in the season during which the nest was constructed. Nests built early in the season by larger fish measured for the most part 14 to 18 inches in diameter and 4½ to 5½ inches, and occasionally 6½ inches in depth at the crest. Mid-season nests built by males of equal size were from 9 to 12 inches in diameter and 3 to 3½ inches, occasionally 4 inches in depth. Late season nests were characteristically very small, usually not more than 7 inches in diameter. The smallest one in the whole season was the last to be built. It was constructed under a large flat rock, and measured 4 inches in diameter and 1 inch in depth. The nesting material was as large as that found in most of the large early nests, but it contained only three hundred stones.

In contrast, one of the first nests to be built, the largest of the season, was 18 inches wide by 5 inches deep. It was composed for the most part of stones from ½ to ¾ inches in their greatest dimension. Taken up at the end of the season, it was found to contain a half bushel of stones.

Late season nests, in addition to their small size and poor selection of site, were characterized by a careless and ragged appearance. One in particular I should never have recognized had I not observed breeding there and subsequently collected eggs. It was an exceedingly flat, scattered pile, lacking the usual slope and crest, and made of stones showing much greater variation in size than usual.

Nests in use did not become silted and thus stood out in some contrast to the rest of the stream bed. Stones on the surface of the nest were constantly shifted about and frequently the male burrowed with the snout into the surface of the nest. These activities were probably connected at least in part with keeping the nest clean. I have also observed bits of silt being swept away by the rapid swimming and turning of the male close to the surface of the nest in defense and rejection. When not in use, the nests lost this clean appearance rapidly and became as heavily silted as other objects in the stream.

Description of Male and Female

Males were larger and more robust than the females. The majority observed were from 4 to 5½ inches in length. Females measured usually not over 3 inches. Differences in coloration of the two sexes were marked. Typically, males were very dark and, seen from above, apparently uniformly colored, individuals differing only in color intensity. Most of the females were much lighter; some were considerably darker than others but none approached the heavy coloration of the males. Many were marked by a conspicuously dark lateral band. When I first observed them at a nest, the dark band, small size and slender bodies caused me to confuse them with black-nosed dace. Evidently the wide variation in female coloration is not connected in any way with readiness of the female to breed. Twelve specimens were taken from nests where breeding was going on. Each differed in some noticeable detail and the group covered the observed range of individual differences. All of these were easily stripped.

All males, where close observation could be made, lost their dark color gradually from the time mating started. This was especially perceptible after the mating period was over, during the time the male remained on guard at the nest. Changes in female coloration were impossible to trace since they are present at nests only while breeding is taking place.

Spawning Time

Breeding began before the nests were completed. Like nest building, it began very slowly during the morning, increased gradually to a peak usually from mid to late afternoon, and subsided in the evening, with absolute inactivity after dark. On ordinary days it was infrequent after 7 P.M. At its height, however, it continued later and on one occasion was observed still going on at 8:30 P.M. Intervals of irregular activity were characteristic of the mating period as well as of the nest building, occurring at the same time. Certain days were marked by rapid and continuous breeding at all nests where it had started. On other days which seemed equally favorable, frequently no breeding occurred at any nest. This condition was accompanied by a noticeable lack of females at or near the nest, and fewer fish of any species were evident in open water. Occasionally, however, on days marked by rapid building and the active presence of other fish in the stream, no breeding occurred. Neither temperature nor other weather conditions could be used to explain this irregularity. Breeding was first observed on May 25, with the water temperature 20° to 21.5°C. While it did not occur on May 26, with the water temperature 20° to 22°, it proceeded at a rapid rate on June 1, with the water at 20° to 20.5°, and occurred consistently on June 2, when the water temperature stood at 17° to 17.5°. Whatever the controlling factor, its effect was felt at all nests.

The time which elapsed between the starting of a nest and the first mating varied with the period in the season. At two nests discovered on May 22, one-fourth to one-third finished, breeding was not observed to occur until May 25. A male was taken on the evening of May 23, from another partially constructed nest which measured 10 inches in width and 3 inches in depth. Stripping could not be effected even under severe pressure, although examina-

tion showed well-developed testes. Evidently the early season males build for a considerable period before they are ready to breed. On the contrary, late season nests, as stated, were frequently used for breeding the day after building was begun. At mid-season nests, building usually continued from three to four days before breeding was observed.

Length of Spawning Period

Variation in the length of the mating period was also evident. Early nesting males were observed to breed over a period of six to eight days, while with the late nesting males, breeding was apparently over in one to three days. However, observation of late season males was less satisfactory. Nesting in shallow water and without protection near, they appeared extremely sensitive to my approach, either through the water or on the bank. From a distance they could be observed breeding from one to three days. Following this time I did not see them at the nest. I am unable to say whether breeding had ceased and they were not at the nest during the day, or whether they had left before I could see them.

Mating

Females were never observed to take any part in the building activities and for the most part their presence at the nest before breeding began was apparently only casual. As building continued toward the time for breeding, they appeared more frequently and began to show more interest in the nest as such. This was evidenced by apparent inspection of the nest and attempts to remain at the nest for longer periods. During this time, however, they were as viciously driven away as any other fish which happened near the nest. When almost ready to breed, the males became less vicious in their attitude toward females, frequently built less rapidly and rested for longer periods on the nest.

The number of females present at a nest during breeding varied from one to twelve; most frequently there were from three to eight. Usually the whole group swarmed the nest at the same time. They were present at the nest only during the day and remained there only while breeding was going on. Females were observed near a nest at night on only one or two occasions, and at these times were inactive.

Mating always took place over the upstream slope. When ready to breed, the male circled the nest, headed upstream and came to rest usually on the crest, where he waited, motionless. Then a female approached, thrust her head under the body of the male near the vent, slid her head along the side of his body and took a position beside him with her head against the rear half of his operculum. Immediately, the two bodies were curved, the female pressed closely against the concave side of the male. The tail of the male was well curved over the caudal end of the female, her tail appearing in somewhat less curve under his body. In this position, they moved upstream from 4 to 6 inches, close to the stones of the breeding slope. This progress was accompanied by a quivering of both bodies, most pronounced at the caudal ends. Just before the mated pair separated there was a marked dip of both bodies which brought the caudal ends very close to the stones and often in actual contact with them. The time of the complete act was from two to four seconds, most frequently three. Characteristically the females took the initiative in approach

for the mating act. Only one instance was observed which might be interpreted as corralling of a female by a male as suggested by Hankinson (1922: 1). There was no apparent preference for right or left side in mating. The approach of the female was always from the rear, or from the side behind the position of the male vent. Before returning to the crest for mating again, the male often burrowed in the stones with his snout, in the area where mating had just taken place, frequently shifting stones about and bringing others from the edge or the downstream bank of the nest. Often the female with whom he had just mated and sometimes others present at the nest took some part in the burrowing.

The whole process, as described, might occur once and be followed by rapid building and vicious rejection, or might occur many times in rapid succession, the male not leaving the nest. At one time it was observed to continue rapidly for fifteen minutes. More frequently it occurred not more than six to nine times without interruption. More typically it was broken by building and defense. At times the male carried one stone between matings, but usually several, being vicious in defense and rejection during the interim.

Mating was usually more rapid when a large number of females were at a nest. The similarity in size and often in coloration made it difficult to be certain whether or not mating took place with all and how many times it took place with any one. It seemed that usually a female was not accepted for mating twice in succession, but occasionally this was observed to occur. One female marked by scar tissue on the head mated with the male three successive times. At this time there were twelve females at the nest.

Typically, mating was with one female only, but at the height of the activity there was often crowding of females. On a few occasions, three females were observed in contact with the male, one on each side and one slightly under. From the position of the male, however, I believe that actual mating took place with only one, the other two having a distinct appearance of merely following the act.

Where the female failed to complete the mating act when once started, the male became particularly vicious in refusal and built in a rapid and nervous fashion. At other times when refusal on the part of the male remained constant over a considerable period, females were observed to simulate the mating act with each other. This differed from mating with the male in that both maintained more nearly the female position.

Care of the Nest

The males were present at their nests day and night from the time building started until breeding had ceased. Some males continued to build slowly and to rework the nest for four days after the last breeding was observed. Others became inactive in one or two days. They could be seen about the nest at least part of the time during the day and always at night, from four to nine days after breeding had ceased. They were present during the night only, from three to seven days more. The shorter time periods were those of the mid-season males. Due to the difficulty in observation of the late season males, it was impossible to tell how long they remained near the nest. Males were frequently sighted in open water but could not be definitely assigned to a nest.

The burrowing into and reworking of the nest were most marked during the spawning period. As stated, the females took some part in the burrowing. This was the only act on the part of the female which might be interpreted as care of the nest. Whether this activity was connected with keeping the nest free from silt or with proper deposition of the eggs, or was evidence of an inclination to take the eggs as food, is a question.

Enemies

The only enemy observed, other than males of the same species, was the common shiner (*Notropis cornutus cornutus*). Shiners were observed to breed at almost every nest some time during the season. They usually appeared when breeding of the cut-lips was at its height and were a highly disturbing factor. Two to four males were usually present at the same time, often fighting among themselves as well as resisting the attempts of the male cut-lips to drive them from the nest. Differing from the quieter mating activities of the cut-lips, they remained in constant motion above the nest, swimming and darting in a nervous manner. Mating of the cut-lips was always definitely lessened and sometimes stopped by their presence and activity at the nest. Shiner eggs were collected in large numbers (200 or more) from some nests.

Burrowing similar to that of the cut-lips but in a more strenuous manner and over larger areas, was carried on by the males of this species. No eggs could be found in their stomachs, however, and I believe burrowing was in connection with deposition of the eggs. Female cut-lips sometimes joined the male in attempting to rout these fish, but usually only when breeding of the cut-lips had been prevented over a considerable period. This was the only evidence of the females taking any part in guarding the nest and their combined efforts were seldom successful.

The Egg

Eggs were always found in the stones of the upstream slope and in no other part of the nest. They were usually increasingly abundant toward a line drawn from the center of the crest to the center of the upstream edge. On examination of nests following a period of rapid or consistent breeding, many eggs were found, single and unattached, in the top layers of the gravel. It would seem that the eggs were laid singly.

All the eggs were flat on one side, this surface resting on the stones. They measured 2 mm. in diameter in any direction. Newly laid eggs were yellowish, clear and glossy above, with the yellow yolk evident toward the base. With the development of the embryo the egg rapidly became opaque and lost its glossy appearance. When in this condition they were normally found adherent to the gravel and deeper in the nest. Most frequently they appeared singly or in twos, but on a few occasions I have seen as many as eight close together on one small pebble. Both eggs and fry have been taken from as deep as 3 inches in the nest. It would seem reasonable that a vertical section of the nest should show successive stages in development at increasing depths. Breeding often extends over a considerable period, and building continues during that time. Thus the older eggs might tend to be buried more and more deeply in the nest. In addition, the force of the current might be expected to wash the eggs

deeper into the inclined stone pile. These successive stages seemed to be evident on close examination, but whether the conclusion drawn is accurate is difficult to say. Disturbance of the loosely constructed nest, under water, may have altered the true conditions to such an extent that accurate observations as deep as 3 inches in the nest were impossible.

The Young

Yolk sacs were evident to the naked eye for about three days after hatching. The fry remain in the nest for some time past this stage. Seven hatchery reared specimens six days old measured 8.5 mm. The largest fry collected from nests measured from 9 to 10 mm. Comparison of these figures would seem to indicate that the young remain in the nest for a period at least exceeding six days.

A conspicuous black lateral band and caudal spot similar to those of the breeding females, appear early. This band was evident on hatchery reared specimens six days old. The development of these markings and the changes in coloration have been watched in laboratory reared specimens. Four specimens, when nearly eleven months old, still showed a strong resemblance to the females in breeding condition. It is possible that these specimens may not have developed normally, since they lived for the last five of the eleven months in a quiet water aquarium under distinctly unfavorable temperature conditions and for the greater part of their lives were fed artificial food. However, specimens taken from the stream showed similar coloration.

Collection of young fish of such size that the cut-lip was visible to the naked eye, indicated that the young fish, like the adults, are most commonly found near the bottom of the stream.

Summary

The nest of the cut-lips minnow is built of pebbles, the size of which is apparently controlled by the size of the mouth of the builder. Early season nests are large and carefully constructed, mid-season nests are smaller; late season nests are very small and carelessly constructed. Likewise the length of the building period varies during the season from more than two weeks to as little as one day. Sites offering protection for the male, such as logs or large flat rocks, are preferred, although late season nests often lack such protection. The shape of the nest is circular where the surroundings permit, and the most constant characteristic is the gentle upstream breeding slope. Nest building began about the middle of May; the peak had passed before the middle of June; occasional new nests appeared until July 11. Building continues throughout the spawning period.

The male, working alone, constructs, cares for and guards the nest. He is active only during daylight hours but is present at the nest day and night from the time building starts until breeding has ceased. He remains at the nest part of the day and during the entire night from four to nine days after breeding has ceased, and during the night only from three to seven days longer.

The females are present at the nest only during daylight hours and only while spawning is actually taking place. They usually appear and swarm the nest in groups, most frequently three to eight in number.

Spawning always takes place over the upstream slope of the nest. Mating is usually very intermittent, being broken by periods of building, defense and rejection; occasionally mating is repeated continuously for as much as fifteen minutes. The length of the breeding period, like that of the building period, decreases as the season advances.

Eggs are found only among the stones of the upstream slope, and are increasingly abundant toward a line drawn from the center of the crest to the center of the upstream edge. They are found singly and unattached in the upper layers of the nests immediately following a period of spawning but are deeper and usually adherent to the stones after development is evident.

The young remain in the nest for a period probably exceeding six days after hatching. The yolk sac is evident for three days.

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Cornell University, Ithaca, New York.

Embryonic and Early Larval Stages of the Grunion, *Leuresthes tenuis*, and of the Sculpin, *Scorpaena guttata* [1]

By Lore R. David

I. The Grunion, *Leuresthes tenuis* (Ayres)

THE egg and embryonic development of the grunion are of special interest because of the peculiar spawning habits of the species, a subject which has been treated at length in a highly satisfactory manner by Clark (1925).

For observations on the embryonic development of the grunion, presented in this paper, egg clusters were dug out from the beach the day after a grunion run; also, eggs were artificially fertilized in the laboratory. The fertilized eggs were kept in running water at a temperature of about 18 degrees C., in standing water at a temperature of 2 or 3 degrees higher, or in sand. The time required for incubation was about the same under all three conditions, i.e., exactly one week was needed for incubation. The highest percentage of

[1] These observations have been carried out during a stay in Scripps Institution of Oceanography, La Jolla, California, in the summer of 1938. My thanks are due to the director and staff of the Scripps Institution for living material and use of laboratory facilities.

eggs actually hatched was obtained from those kept in running seawater. Of these more than 85% developed. It was difficult to maintain natural conditions for the eggs developing in sand because the growth of bacteria could not be controlled and the requisite degree of moisture was difficult to determine.

The high percentage of eggs hatching out among those that had been kept in running water seems to indicate that there is no adaptation of the metabolism during embryonic development to life in the sand, but that the peculiar spawning habit of the fish serves merely to give protection to the egg. The nearest relatives of *Leuresthes* for instance, *Atherinopsis californiensis* Girard (Clark, 1929) or *Menidia menidia* (L.) (Hildebrand, 1921), spawn in shallow water near the coast, and the eggs adhere to eel-grass by means of gelatinous threads. Most of the eggs of *Leuresthes* kept in quiet water or in sand did not hatch until subjected to a strong incoming stream of water. Thus eggs that had been spawned the 15th of July were kept in standing water until the 30th of July and then subjected to a stream of running water; a number of larvae hatched at once. Larvae that hatched fourteen days after fertilization showed no difference whatever from those that had hatched after eight days.

The grunion egg is more or less spherical, with a diameter of 1.5 to 1.6 mm. and a perivitelline space $\frac{1}{5}$ to $\frac{1}{2}$ mm. wide. The blasto-disc may be more or less elongate, its diameter being about 1 mm., its depth $\frac{1}{5}$ mm. The newly deposited egg is easily distinguished by the many dark orange oil globules, which vary in size and number greatly. Rarely are there as few as 25, and usually there are more than 115. The great mass of them lies in the center of the upper side of the egg. Around the periphery of the newly spawned egg lie a number of very small globules which disappear during the first day of development. The size, number and color of the globules change during development, until finally there remains only one large uncolored oil globule in the yolk sac of the young larva. The egg is semitransparent and a clear yellow green in color. It is demersal. Twelve hours after fertilization (Plate I, Fig. 3), cleavage is nearly complete.

Eighteen hours after fertilization, the embryonic axis is formed. Then the embryonic area is a narrow longitudinal ridge about 1.6 mm. long and 0.15 mm. wide. The germ ring has a diameter of about 1.2 mm. and a width of 0.25 mm. The blasto-derm has advanced over more than 3/5 of the yolk. thirty-four hours after fertilization, the lens and the fourth ventricle are well formed; the auditory capsules are visible; 14 somites are differentiated (19 somites after forty hours) and Kupffer's vesicle is detectable. The head lies still closely attached to the yolk. The oil globules, still dark orange, have decreased in number in some cases; the size of some globules has increased and smaller globules may be subdivided. Forty-six hours after fertilization a slight beating of the heart is perceptible.

Sixty-two hours after fertilization, head and tail are detached from the yolk and the embryo is capable of considerable movement, the tail being partly free. The cerebellum fold is visible in the brain. Circulation can be observed in three vessels coursing around the yolk and through the body of the embryo. The formation of somites is nearly completed; 41 or 42 can be counted.

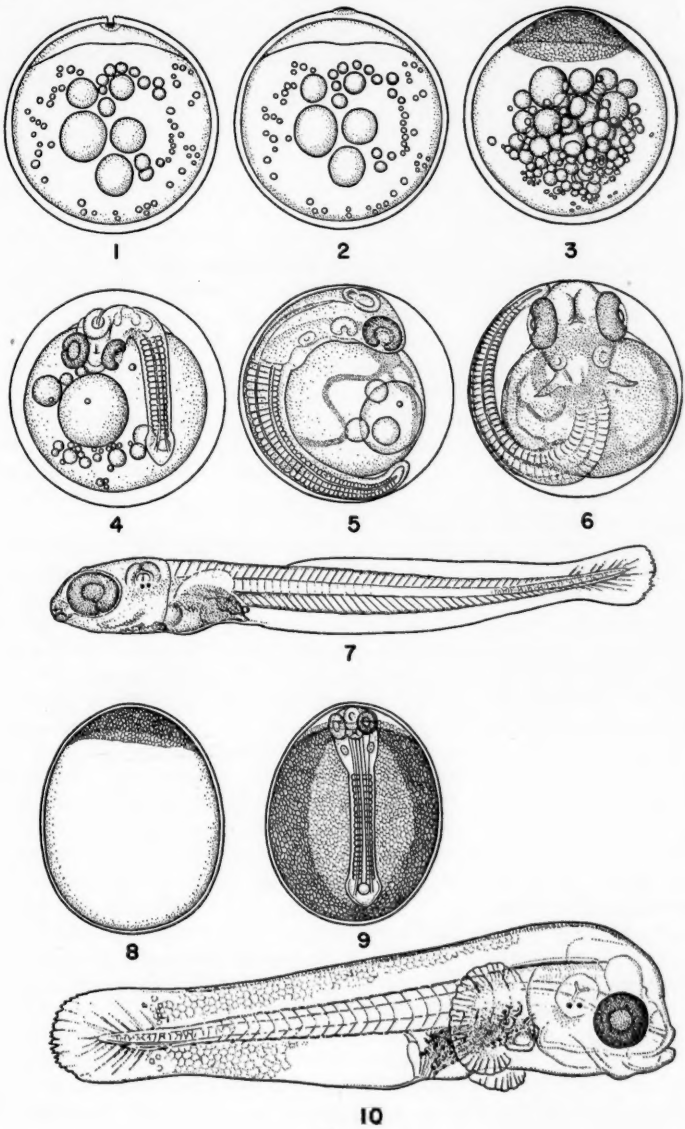

Plate I

1. Egg of the grunion, diameter 1.55/1.65 mm., before fertilization. 2. Same egg, immediately after fertilization. 3. Egg of the grunion, 12 hours after fertilization. 4. Egg of the grunion, 34 hours after fertilization. 5. Egg of the grunion, 60 hours after fertilization. 6. Egg of the grunion, 132 hours after fertilization. 7. Larva of the grunion, two weeks old; length 9 mm. 8. Sculpin egg, 10 hours after fertilization. Diameter 1.2 by 1.4 mm. 9. Sculpin egg, 34 hours after fertilization. 10. Larva of the sculpin 13 days after fertilization. Length 3 mm.

The remaining oil globules are centered around one large one. Only 18 were found present in an individual that originally possessed 114. Their carotenoid color has vanished, and they now seem to be of the same clear yellow as the yolk.

Eighty-four hours after fertilization, the embryo has attained more or less the external shape it possesses on hatching. The eyes are colored black, the auditory capsules show two otoliths. The myomeres could not be counted with absolute certainty due to the twisting of the embryo; 45 or even more were observed. The blood corpuscles are easily visible and are now colored red. Melanophores are developed on the head and along the upper part of the sides as well as above the intestinal tract. One or a small number of uncolored oil globules are present.

The embryo has attained its full length one hundred eight hours after fertilization. The melanophores are further differentiated and a few yellow chromatophores are scattered between them. The exact time when they appear first was not observed. The peritoneum above the intestinal tube has become more and more blackened. The pectorals measure half the diameter of the eye and are pointed at their ends. Only one large oil globule is present. The pectorals have grown to $\frac{2}{3}$ of the diameter of the eye one hundred thirty-two hours after fertilization.

About one hundred eighty hours after fertilization, the larvae begin to hatch.

The newly hatched larva measure 6.5 to 6.75 mm. in length. They still possess a large ellipsoid yolk sac, with a big oil globule at its anterior end. The heart is situated immediately in front of the yolk mass. The mouth is open. The first buds of the gill-leaflets are visible. The pectorals are leaf-shaped and slightly longer than the diameter of the eye. The dorsal fin-fold has its origin a little behind the anus and is continuous with the ventral fin-fold, which originates behind the anus. The dorsal measures $\frac{1}{5}$, the ventral $\frac{2}{5}$ the height of the body behind the anus. The intestinal tube is still more or less straight. The anus lies at the end of the first third of the body. There are 44 or 45 myomeres behind the opercle. The melanophores, which at first were contracted in specimens observed, expanded soon after hatching. On the head are two small melanophores above the nasal region, one above the dermethmoid, and two larger ones between the posterior part of the eyes; also there is a group of larger melanophores in the frontal region and another one in the occipital region. At least 16 melanophores can be counted along the dorsal line of the body. A few yellow chromatophores are spread throughout the melanophores.

The larvae were kept for a little more than two weeks in the aquarium.

An animal of three days measures 7.8 to 8 mm. in length. It still possesses yolk, which is not visible from the exterior. The intestine is more convoluted. The pectorals measure $1\frac{1}{4}$ times the diameter of the eye. The head begins to attain its definite shape after the second day. By eight days, the jaws are strongly built and the mouth, which at hatching was inferior, has now become terminal. The last of the yolk has been absorbed between the fifth and sixth day of larval life.

Larvae of two weeks measure about 9 mm. The bones of the head have assumed the characters of the adult fish. The branchial arches are distinctly differentiated. The pectorals measure 1⅓ times the diameter of the eye. The dorsal and ventral fin-folds begin to enlarge at the location of the future fins. A number of definite fin-rays are present in the caudal fin.

The larvae were fed on diatoms cultivated in the laboratory, or on plankton from fresh tows. Beginning with the third and fourth day Rhizosolenia, Chaetoceros, and in a few cases, small crustaceans were found in the intestine of the larvae.

The young larvae began to swim actively immediately after hatching. Their heads were in constant contact with the surface-film of the water, as Hubbs (1921) has described for *Labidesthes sicculus*. The young larvae continued this movement along the surface without interruption, as long as they were observed. After five days, and particularly after the ninth day, they began to swim about more freely and descended a little below the surface of the aquarium, evidently to look for food. Animals that had lost strength let themselves fall to the bottom, managed to come to the surface again, but finally died.

II. The Sculpin, *Scorpaena guttata* (Girard)

Barnhart (1932) has given an account of the spawning of this fish, which is locally called sculpin, and has described some of its larval stages. We add here additional data concerning its embryonic development.

The sculpin spawns during the summer from May to September. Since the egg "balloons" were found in the aquarium in the morning with the eggs always in the same degree of development, i.e., advanced blastoderm, spawning apparently always takes place at the same time during the night, i.e., around midnight. The hours given below are counted from this time. There may be a slight deviation from the actual time of spawning, but probably not more than one to two hours.

The eggs were hatched in the laboratory. Those left in the entire gelatinous egg "balloons," even though kept in running water did not live one day. If the eggs were freed from the gelatinous mass and very small groups of them kept in running water, a large number of them hatched. Under what conditions in nature does the embryonic development take place so as to guarantee the hatching of the animals? The egg "balloons" drift at the surface of the sea and are possibly aerated there as a result of being buffeted about by the waves.

The egg of the sculpin is ovoid in shape, with a major axis from 1.22 to 1.29 mm. and a minor axis from 1.16 to 1.19 mm. The perivitelline space is hardly perceptible. The egg is perfectly colorless and transparent, and there is no oil globule.

The first stage observed was the blastodisc in advanced cleavage, the diameter of which was 1 mm., the height ⅕ mm. Invagination begins about twelve hours after fertilization. Fifteen hours after fertilization the embryonic axis, extra-embryonic area and germ ring are differentiated. Twenty-two hours after fertilization the blastoderm has enclosed ⅘ of the yolk. About 7 somites are indicated.

Thirty-four hours after fertilization, a distinctly shaped embryo is formed

with 14 somites; the fourth ventricle of the brain, the lens, the auditory capsules with two otoliths each are formed. Kupffer's vesicle is very prominent. Sometimes two vesicles seem to be visible, a phenomenon which has been observed in *Oxyjulis californicus* by Bolin (1930). The blastoderm has spread over the whole yolk and a very characteristic large-celled membrane covers yolk and embryo. The entire egg is still without pigment.

About fifty-eight hours after fertilization hatching begins, although most hatch during the following night. The newly-hatched larvae of this stage measure 1.9 to 2 mm. in length (1.26 mm. to the anus, 0.75 mm. to the end of the tail) and are 0.85 mm. in depth. The yolk sac is voluminous, showing one or two little vesicles at the posterior end that may be the remains of Kupffer's vesicle. There is no indication of mouth or jaws. Nineteen myomeres are clearly visible. A little ellipsoidal bud indicates the future pectoral fin. The dorsal fin-fold begins on the anterior surface of the head and is continuous with the ventral fold that begins posterior to the anus. The dorsal fin-fold measures slightly more than $\frac{1}{3}$ of the depth of the body measured just posterior to the anus; the ventral fin-fold is $\frac{2}{5}$ to $\frac{1}{2}$ as high as this measure. Melanophores occur in the peritoneum above the intestinal tube. The embryo is remarkable because of the peculiar cells in the skin. A line of large cylindrical cells borders the dorsal fin-fold beginning before the head and ending above the eighteenth myotome; and large round cells are conspicuous all over the body.

Twenty-four hours later, i.e., about four days after fertilization, all the larvae hatched, their length being 2.5 to 2.7 mm. Then 22 to 24 myomeres are present. Melanophores have spread over the peritoneum above the intestinal tract; and a few lie along the ventral side of the body; the pectoral fin-bud measures $\frac{2}{3}$ the diameter of the eye.

Twenty-four hours later, about one hundred six hours after fertilization, the yolk has been absorbed to half its original size. Several convolutions of the intestine are perceptible. The pectoral fin measures $\frac{5}{6}$ the diameter of the eye.

The mouth becomes differentiated on the sixth day after fertilization. The yolk sac is absorbed during the eighth day after fertilization. Thirteen days after fertilization the larvae were less than 3 mm., a measure that may be small due to unfavorable conditions in the laboratory. The jaws are well formed; opercle, parasphenoid, pectoral girdle and bones of the cranium can be distinguished. The pectoral fin measures twice the diameter of the eye. Melanophores are spread over the base of the pectoral fins, and numerous small black lines along the fin-rays color their borders. The intestinal tract is entirely covered with black pigment. A few melanophores are visible at the tail.

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325 SOUTH CRAIG STREET, PASADENA, CALIFORNIA.

Growth of Bass Fry

By KENNETH H. DOAN

CONSIDERABLE effort has been expended by various workers in measuring not only the lengths of fishes but also the dimensions of their parts. However, not all of the results so obtained seem to indicate a universal agreement on just how the various parts grow in relation to the fish as a whole.

Crozier and Hecht (1914) and Hecht (1916) made the generalization that the dimensions of the parts of the bodies of fishes are the linear functions of the total lengths. It was later brought forward (Lebour, 1919–22) that certain parts of young pilchard, sprat and herring do not grow in linear proportion to their growth in length. Replotting of Lebour's data suggests that a logarithmic treatment of the relation between the growth of the forepart of the body and that of the total length might help in interpreting her data. No break or change of direction in the straight line obtained by logarithmic use of Lebour's data is evident at the point designated "metamorphosis." Lebour agrees with Fage (1920) in attributing to the tail region of these fishes a faster growth than to the region of the trunk.

Hubbs and Whitlock (1929) in a paper on the type of young in the gizzard shad remarked that the early period of growth of these fishes seemed to be logarithmic, but not of the simplest order, and derived formulae to express the curves obtained from the observed data. They further remarked that the marked changes in the increments of the growth of the different parts of the body, which seem to be characteristic of very young fishes, are carried with decreasing intensity well into and perhaps entirely through the whole life-cycle. But, the dimensions of the parts of a fish throughout the greater portion of its life-history do bear a relation closely approaching that of the linear

to the total length. They cautioned against the use of the proportions of the body in the young as racial or specific characters.

In the whitefish, the length of the fins on the ventral part of the body increase proportionately faster than the body length, and the head with its parts, particularly the eye, increases more slowly (Hart, 1931).

Since the appearance of Huxley's publication (1932) dealing with some of the problems of relative growth, considerable attention has been turned towards studies of the differential growth of parts of animal bodies, using the logarithms of the values obtained in measuring the body and its parts. The results of Ford's studies on the growth of larval and post-larval stages of herring (1930) pilchard and sprat (1931a), and of the freshwater eel (1931b) have been further applied, by Huxley, to considerations of regions of different growth-gradients within the same body.

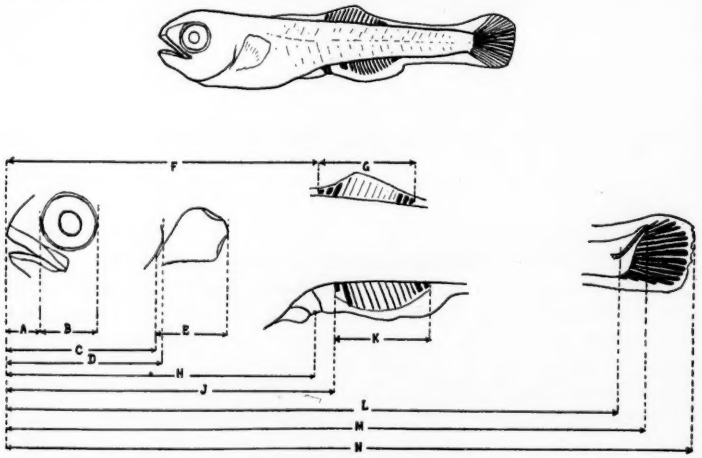

Fig. 1. Illustration of measurements made on bass fry.

B—Diameter of eye; D—Tip of snout to margin of opercle, or head length; E—Length of pectoral fin; F—Tip of snout to base of first dorsal fin ray; G—Length of dorsal fin between first and last fin rays; J—Tip of snout to base of first anal fin ray; K—Length of anal fin between first and last anal fin rays; L—Tip of snout to caudal up-bend of vertebral column.

The present study consists of a series of measurements on fry of the small-mouthed black bass (*Micropterus dolomieu* Lacépède), which were taken from the immediate vicinity of an isolated bass nest in Mitchell's Bay, Lake St. Clair, Ontario, June 12–29, 1935. This particular study, part of a larger program, was made possible through the assistance of the University of Toronto, the Ontario Department of Game and Fisheries, and the Royal Ontario Museum of Zoology. The author is pleased to acknowledge the kind supervision of Professor W. J. K. Harkness, director of the Ontario Fisheries Research Laboratory, and wishes also to thank Dr. F. E. J. Fry for invaluable help and suggestions.

The fry were collected with a 6-foot small-meshed minnow seine, and were preserved in 70% alcohol. Measurements were made with a calibrated slid-

ing stage microscope and micrometer, capable of readings to the nearest 1/10 mm. Water temperatures were recorded by a maximum-minimum thermometer set at the nest. The parts of the fry which were measured are shown in Fig. 1, and the average values of the measurements are given in Table 1 and illustrated in Fig. 2.

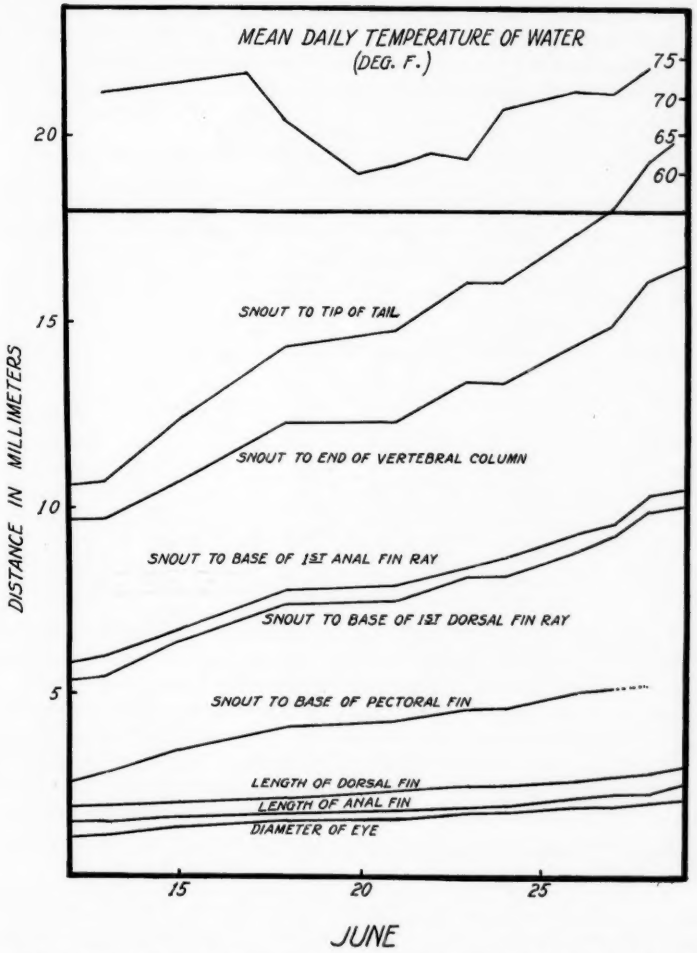

Fig. 2. Growth of parts of bass fry, and temperature, Mitchell's Bay, Lake St. Clair, 1935.

It is to be observed in Fig. 2 that not only did growth in total length of the bass fry suffer checks when drops in water temperature occurred, as from

73 to 58.5°F. between June 17 and June 20, but the growth of various parts of these fry showed checks also, as might be expected.

The arithmetic proportions of different parts to the standard length, i.e., the distance from the tip of the snout to the caudal up-bend of the vertebral column, were calculated. These values for the head length, length of pectoral fin, and the distance from the snout to the base of the dorsal fin increased gradually with increases in the standard length. The proportions of the dorsal and anal fins, on the other hand, decreased, and no definite trend was noted in the ratios for the other body parts measured. There was a tendency for the arithmetic ratios to approach constancy with increase in standard length.

TABLE I

AVERAGE MEASUREMENTS ON YOUNG BASS FROM LAKE ST. CLAIR, 1935
All distances in mm.

Date	No. of fish measured	Tip of snout to caudal up-bend of vert. column	Diam. of eye	Head length	Length of pectoral fin	Tip of snout to base of 1st dorsal fin ray	Length of dorsal fin	Tip of snout to base of 1st anal fin ray	Length of anal fin
June 12	6	9.2	1.1	2.6	1.0	5.4	1.9	5.8	1.5
13	6	9.3	1.2	2.8	1.0	5.5	1.9	6.0	1.5
15	6	10.5	1.4	3.4	1.3	6.4	2.1	6.8	1.6
18	6	12.3	1.5	4.1	1.8	7.4	2.2	7.8	1.8
21	6	12.3	1.5	4.1	1.8	7.5	2.3	7.9	1.7
23	6	13.4	1.7	4.5	2.0	8.1	2.5	8.4	1.9
24	6	13.3	1.7	4.5	2.1	8.1	2.4	8.6	1.9
26	6	14.4	1.9	4.9	2.2	8.8	2.6	9.3	2.1
27	5	14.8	1.8	5.1	2.4	9.2	2.7	9.5	2.2
28	5	16.1	2.0	5.4	2.6	9.9	2.8	10.3	2.2
29	4	16.5	2.0	5.0	2.6	10.0	3.0	10.5	2.5

The eye and head, and the pectoral and anal fins did not continue to grow at the same rate as the body as a whole. Among the fry, the eye and head assumed a slower growth, and the pectoral and anal fins a faster growth, in comparison to the growth of the body as measured by standard length. The points at which the growth rates changed are more easily detected by the use of logarithms. When the logarithms of the average lengths of parts of the body at different ages were plotted against the logarithms of the average standard lengths of the same fish at the same ages, distinct breaks in the resulting straight lines were noted (Fig. 3) which indicate where the growth rates changed.

The diameter of the eye and the length of the head altered their straight-line relationships to the standard body lengths when the fish were about 9.6 mm. in length. The relationships of the lengths of the pectoral and anal fins to the body lengths changed in value when the fish reached a length of 12.9 mm. In the cases of the distances from the snout to the bases of the dorsal and anal fins, and the length of the dorsal fin, no breaks in the straight lines have been detected.

If the process of growth is considered as a multiplication of cells, then

increase in size should be logarithmic. When increase in size does not continue logarithmically, then such factors as expansion or compression of cells may be exerting an influence and modifying or masking the logarithmic increase.

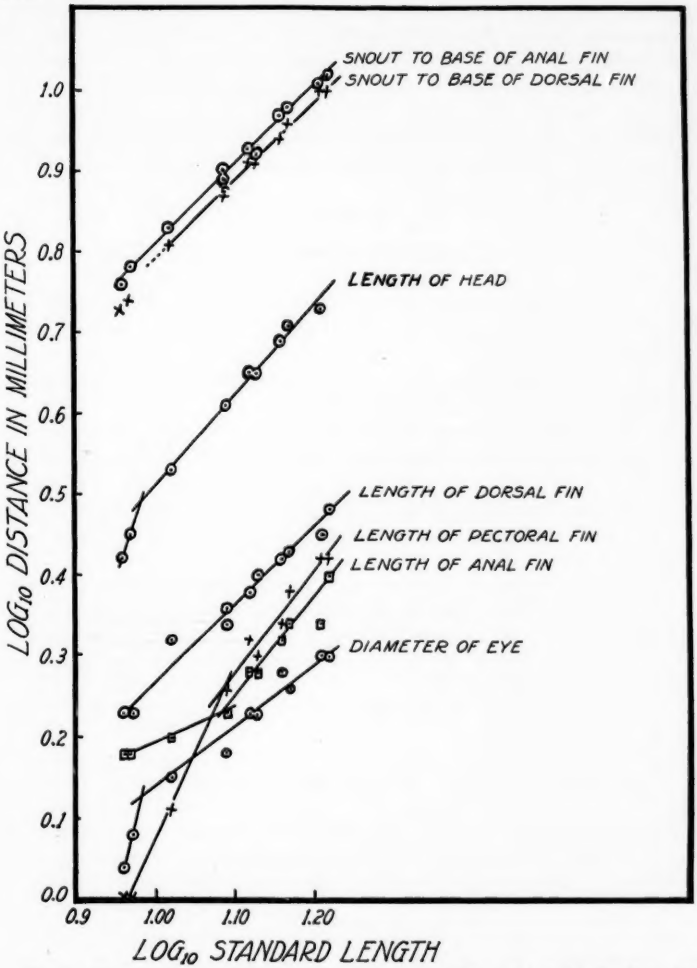

Fig. 3. Changes in rates of growth of various parts of bass fry, Lake St. Clair, 1935.

In the bass fry studied, the growth of parts continued logarithmically, but not always at the same rate. In an individual bass the proportions of the sizes of parts to standard length are changing. Therefore, measurements made at any one time would not be in the same proportion as those made at some other time. And furthermore, a statement of measurements of proportional

parts, made at any one time, would not fully delimit the morphometry of a single fish, and much less of the species.

When the taxonomic use of proportional parts is pursued to extremes, there is danger that the supposed validity of the specific or subspecific determination is on a questionable basis. It would be of value to have a series of measurements on one year class from hatching to maturity, and thus to know more completely a species by its own idiosyncratic growth. It is suggested that the general principles of growth characteristic of a species hold over repeated generations of that species, but modifications due to temperature, food, mutations or other causes may occur. Extremes of these modifications might eventually lead to the founding of a new species, based on a different growth of the body and its parts.

Summary

1. Some aspects of the growth of small-mouthed black bass fry from Mitchell's Bay, Lake St. Clair, Ontario, have been studied.

2. A fall in water temperature from 73 to 58.5°F. over a 3-day period was associated with a decrease in the rate of growth of parts of bass fry as well as their total length.

3. The arithmetic proportions of parts of bass fry to standard length approached constancy with increased length.

4. The relation between growth of parts of bass fry and that of the standard length was found to be logarithmic. The values of this relation altered at a standard length of 9.6 mm. for the diameter of the eye and the length of the head, which decreased in growth rate; and altered at a standard length of 12.9 mm. for the lengths of the anal and pectoral fins, which increased in growth rate.

5. Some indication of inherent metamorphic changes in the growth of bass fry is in evidence. The use of proportional parts may lead to error in defining a species from samples within a limited size range, but a knowledge of the peculiar growth of individuals of an extended series would be an aid in differentiating species.

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FRANZ THEODORE STONE LABORATORY, OHIO STATE UNIVERSITY, PUT-IN-BAY, OHIO.

Growth in the Eastern Box-Turtle, with Special Reference to the Dermal Shields of the Carapace

By H. E. EWING

THE number of annual growth zones concentrically arranged about the focal areas of growth of the dermal shields, or scutes, of box-turtles have long been used as age indicators by amateur naturalists. It was while attempting to check the number of such growth zones on each shield with the known age of young turtles that the writer decided to attempt to discover more precisely the manner in which these growth zones are formed and to find out other facts of interest relative to the growth of box-turtles. (For the deeper significance of the relationships of girdles, ribs, and carapace in turtles, cf. Ruckes, 1929.) The eastern box-turtle, *Terrapene carolina* (Linnaeus), was selected for the writer's work.

As a method of recording the outer shape and appearance of the shields on the carapace, at the end of the active season of each year plaster casts were made of a few turtles for permanent record and for comparison with other casts made a year or period of years later of the same individuals, or for comparison with the carapaces of the living turtles. Photographs were also made of single scutes (Fig. 3). Pencil stenciling by means of tissue paper was still another method of recording the size and markings of the shields.

By making casts of the carapace of a turtle each year at the end of the growing season it was possible not only to determine accurately just what growth took place for several years around the margins of each of the dorsal shields but any other change affecting the surface of these horny structures. If inactivity of a turtle during the summer season should cause the production of pseudoannual growth zones, by this method such zones could be detected and studied. Also if activity continued throughout enough of the year to reduce the groove between two annual growth zones greatly and make them appear as one, such shallow grooves could be detected and studied.

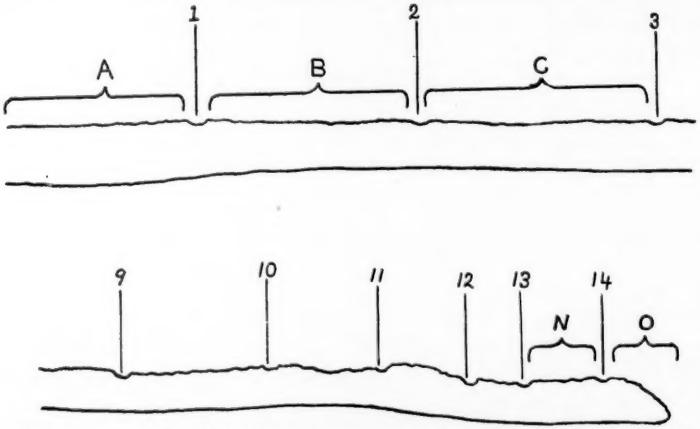

Fig. 1. Part of a cross section of a costal shield of *Terrapene carolina*, x32. Above: Cross section of first three growth zones on front part of shield. Below: Cross section of ninth to fifteenth growth zones of front part of same shield. Nos. 1–3 and 9–14: Grooves formed during dormant season which separate growth zones. Letters A–C and N, O: First three and last two growth zones respectively.

The Molting of the Outer Layers of the Dermal Shields in Certain Turtles

Many turtles at the time of molting cast the outer layers of the dermal shields. These usually come off irregularly at the time of the general molt, which takes place in the early part of the summer. At times, however, the old horny layers do not loosen and may not be cast for two or more years. Before the old layer is cast it becomes loose about the edges, so that by means of a knife blade it may be detached prematurely, disclosing the light colored newer layer of horny substance. Concerning the molting of the dermal shields in *Chrysemys picta*, Babcock (1919: 369) states: "In molting, the skin of each shield is shed separately, and resembles a thin sheet of mica."

No Molting of Dermal Shields in Box-turtles

In box-turtles, however, there is no molting of the outer part of the dermal shields; hence the growth zones and the grooves separating them that are recorded on a previous plaster cast will show on all subsequent casts provided that the scutes have not been badly worn.

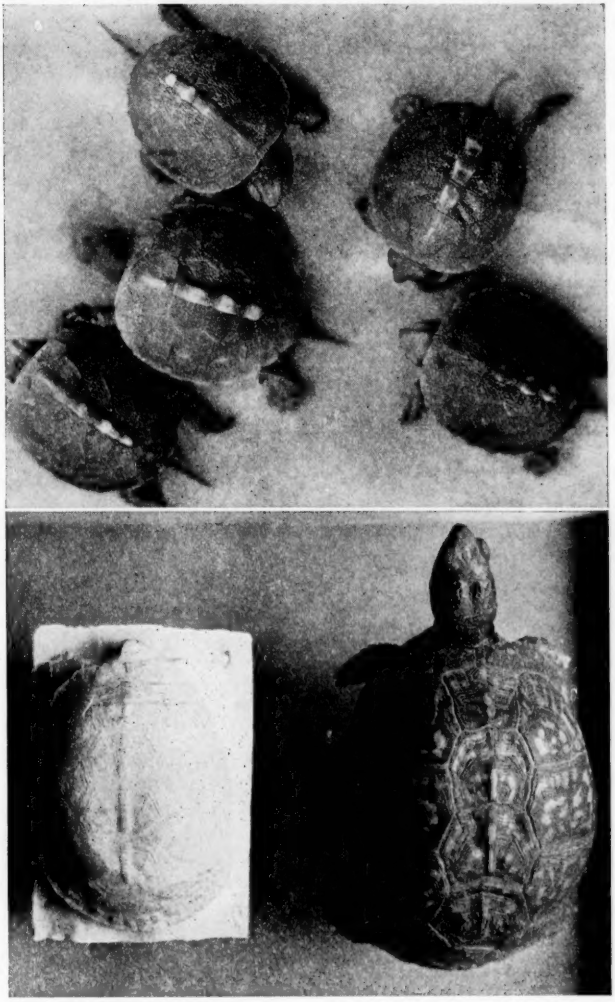

Fig. 2. Above: Young individuals of *Terrapene carolina* only a few days old; natural size. Note the absence of growth zones about dermal shields. Below: A box-turtle (*T. carolina*) photographed Oct. 21, 1934, with its plaster cast which was made eight years earlier on Sept. 28, 1926.

The Seasonal Formation of the Growth Zones

Upon hatching, the dermal shields of a box-turtle have a very rough outer surface (Fig. 2, above) and match each other at their margins. Later these roughened areas, which mark the original size and shape of each dermal shield, become somewhat smooth because of wear and are separated from each other by growth zones.

As can be seen by observing the growth of very young box-turtles, the first growth zone is laid down only during the active season of the year following hatching. At the end of the first active season the first annual groove has not yet been formed. This is observed, however, early in the summer of the following year as soon as the growth of the second annual zone begins. The start of this second zone is at a slight distance from the first one, thus producing a groove. It is evident that the annual grooves are produced by the slower and more irregular formation of the horny substance during the period of hibernation.

A Cross Section of a Dermal Shield from the Carapace

When a shield from the carapace of *T. carolina* is examined in cross section (Fig. 1) it is observed that the thickest part is the focal area of growth, which is the area of the shield at the time of hatching. As the succeeding growth zones are laid down they tend to become thinner for a very few years only, after which there is considerable variation (Fig. 1) in their thickness. By actual measurement the thickness of the focal area of growth and the subsequent concentric growth zones of the third left costal shield of an eastern box-turtle were found to be:

Thickness of focal area of growth	0.310 mm.
Thickness of first growth zone	0.240 mm.
Thickness of second growth zone	0.170 mm.
Thickness of third growth zone	0.175 mm.
Thickness of fourth growth zone	0.165 mm.
Thickness of fifth growth zone	0.140 mm.
Thickness of sixth growth zone	0.140 mm.
Thickness of seventh growth zone	0.150 mm.
Thickness of eighth growth zone	0.130 mm.
Thickness of ninth growth zone	0.180 mm.
Thickness of tenth growth zone	0.150 mm.
Thickness of eleventh growth zone	0.155 mm.
Thickness of twelfth growth zone	0.195 mm.
Thickness of thirteenth growth zone	0.185 mm.
Thickness of fourteenth growth zone	0.175 mm.

Thus in this particular instance the first growth zone was much thicker than any of the others, while the thinnest of all was the eighth. The second thickest growth zone was the twelfth, one of the last to be formed. Each yearly growth zone had apparently attained its full thickness by the time it was laid down, thus demonstrating that in the box-turtle the elaboration of the horny substance which makes up the scutes takes place at their margins, in other words, at the grooves in the carapacial skeleton which mark the positions of these shields. This process is very different from that occurring in many other turtles, where the elaboration of this horny substance takes place over the entire under surface of the shields.

This latter method of growth of the shields is the one obtaining in *Chelys* according to Hay (1928: 11) who states: "The shields do not grow at their edges merely, but a new layer of horn is laid down on its whole lower face, and these layers may often be separated from one another."

The early growth zones exceed the others in width. As a turtle approaches maturity the growth zones become so narrow that they cannot be successfully identified. In Figure 1 note how broad the first, second, and third growth zones are in comparison with the twelfth, thirteenth, and fourteenth.

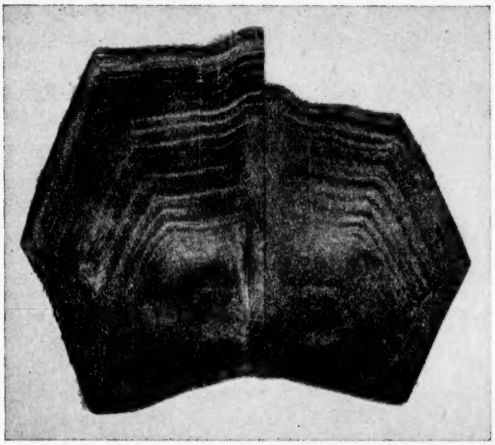

Fig. 3. Left half of third vertebral shield of a box-turtle, *Terrapene carolina*, photographed Oct. 14, 1934, and right half of the same shield of same turtle from plaster cast made six years earlier on Sept. 30, 1928. Twice natural size.

On March 5, 1934, a female with some carapacial shields missing was observed near the hibernation hole from which she had only that day emerged. An investigation of the vacant hibernation hole revealed a third left costal shield adhering to the roof. The previous winter of 1933–'34 had been a very severe one at Washington, with temperatures below zero. Presumably the shield had frozen fast to the soil, and possibly had also been loosened from the bony plates by freezing.

Pseudoannual Growth Zones

Having detected pseudoannual growth zones by the methods already described, an attempt was made to find out how to identify them in nature. No sure method was found. However, most of these pseudoannual growth zones have the following characteristics: They are narrower than would be expected for their position relative to the other growth zones. They are limited usually on one margin by a groove much shallower than those on either side of a true annual growth zone. Finally, the groove limiting a pseudoannual growth zone on one, or possibly both, of its margins, usually

fails to register on the angular turns of the growth zone along the radiating ridges. Keeping these characteristics in mind an experienced observer should be able to detect most of the pseudoannual growth zones that he observes.

The Dropping of Dermal Shields by Turtles in Nature

Box-turtles with one or more of the dermal shields missing are frequently observed. These turtles do not appear to be seriously inconvenienced by the loss of such protecting parts. Forest fires have been ascribed as the cause for the loss of such shields, but an observation made by the writer indicates that freezing also may cause their loss.

Increase in Length During the Growth of a Box-Turtle

On September 28, 1926, the writer made a plaster cast of a turtle named Riggs 2. The length of the carapace in this plaster cast is 93.0 mm. On November 28, 1937, the length of the carapace of this turtle was 126.5 mm. Thus in eleven years this turtle had grown 33.5 mm. in length, an average of 3.05 mm. per year. Most of this growth took place during the first eight years, as yearly weighings of the turtle and stencil records of its carapacial shields show.

If it is assumed that at hatching Riggs 2 was 30 mm. in length (about an average length for a newly hatched individual), its total growth was 96.5 mm. If the rate of growth noted for the last eleven years of her life had been maintained throughout the whole of it, an estimate of 31.64 years is obtained for the age of this individual at the time of measurement. (This turtle, it might be noted, is still living and in good condition.)

Observations on the widths of growth zones as laid down during the life of a box-turtle show that they are considerably broader during the first few years, so that this estimate is evidently too high.

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U. S. National Museum, Washington, D. C.

Differences in the Young of *Eumeces fasciatus* and *Eumeces laticeps*

By Robert H. McCauley, Jr.

In view of the uncertainty among herpetologists with regard to the relationships of the two species of *Eumeces*, *E. fasciatus* (Linnaeus) and *E. laticeps* (Schneider), since the recognition of the latter by Taylor in 1932, it seems desirable to present any data bearing on the problem. Burt (1937: 359), in a recent discussion of this problem, rejects the validity of *laticeps*. I have had the good fortune to hatch a number of young of *E. laticeps* and *E. fasciatus*, and have compared these individuals with respect to certain diagnostic characters mentioned by Taylor (1935) in his comprehensive study of the genus. All measurements are in millimeters.

The specimens under consideration are as follows:

One female *Eumeces fasciatus*, No. L71, taken July 1, 1937, near St. Inigoes, St. Mary's County, Maryland, by the Reverend W. H. McClellan, S.J., and myself, laid three eggs July 5 and 6, which hatched about August 30, 1937.

Three female *E. fasciatus*, Nos. L119, L120, L121, taken July 14, 1938, near Queenstown, Queen Anne's County, Maryland, by Mr. L. E. Taylor of Centerville, Maryland, and myself, each found brooding a clutch of eggs. These clutches were very close to each other, and in the confusion of capture of the brooding females, became mixed. The total number of eggs was twenty.

One female *E. laticeps*, No. L109, taken June 22, 1938, near Centerville, Queen Anne's County, Maryland, by Mr. L. E. Taylor and myself, laid ten eggs in captivity July 12, 1938, six of which hatched later.

The ten *laticeps* eggs, when laid July 12, averaged 14.7 by 9.7 in length and breadth, the extremes being 13.5–17 by 9.3–10. On August 1, eight of these averaged 17.4 by 12.5; extremes were 16–19 by 12–13. On August 10, average measurements for eight eggs were 19.8 by 13.9, extremes being 18–21 by 13.5–14. The eggs of *fasciatus* were not measured.

The above measurements differ somewhat from those of Noble and Mason (1933). At the time of laying, *laticeps* eggs measured by them were 15–18.5 by 9, exhibiting a slight difference in shape and slightly greater size than those considered above. At the time of hatching, their eggs were recorded as 17–20 by 12, while mine measured 18–21 by 13.5–14, twenty to twenty-five days before hatching. The latter are therefore definitely larger, and in comparison with the *E. fasciatus* eggs measured at hatching by the above authors (19–21 by 12–12.5), they are definitely larger in the smaller diameter.

Six *laticeps* and twenty-three *fasciatus* were hatched from the eggs under observation. Both parents and young were examined with special attention to the distinguishing characters of the two species. The average snout to vent measurement of the young *laticeps* is 31.2, the extremes being 30.5–32. The *fasciatus* young average 26.2, extremes being 25.5–27.5. The average difference in head-and-body length between the species is 4.9. These measurements are at some variance with those of Noble and Mason (1933), whose average snout to vent measurement for eight young *fasciatus* is 24, and for

five young *laticeps* 26.8. The average length of the heads of the six *laticeps* is 9.1, varying from 9 to 9.5. That of twenty-three *fasciatus* is 7.8, varying from 7 to 8 (measured from the posterior edge of the ear opening). The average width of head of the *laticeps* is 6, that of the *fasciatus* 4.8, varying from 4.0 to 5.0.

The number of scales around the middle of the body in *laticeps* is 32 in four individuals, and 33 in two, while in *fasciatus* seven have 28, three have 29, eleven have 30, and two have 31. The supralabials on each side are as follows: *laticeps,* right side, three have 8, three have 7; left side, two have 8, four have 7 (four have 7 on one side, 8 on the other); *jasciatus,* right side, five have 8, one has 7½, seventeen have 7; left side, five have 8, eighteen have 7 (four have 7 on one side, 8 on the other). Infralabials are less variable; all specimens of both species have 7 on each side, except one *laticeps* which has 8 on the right. Postlabials are very constant. In the young *laticeps* they are invariably absent or so minute as to be indistinguishable from the very small scales around the ear opening, while the young *fasciatus* invariably bear 2 well defined and distinct postlabials on each side of the head. In all specimens of *laticeps* the secondary temporal is enclosed posteriorly by the elongated last labials and the tertiary temporal. In all the *fasciatus* specimens this scale is enclosed by the last labial, the tertiary temporal, and the upper postlabial. The condition of the prefrontals is as follows: in contact in all the *laticeps,* and in eighteen of the *fasciatus* (barely touching in two); not in contact in five *fasciatus.* The subdigital lamellae, though quite variable even in the same animal, are found to be within a fairly constant mean of 16–17 for both species.

With respect to markings, all six specimens of *laticeps* show 7 well defined longitudinal light lines, while all twenty-three *fasciatus* with equal constancy show only 5 lines.

Several constant differences are thus apparent in this material. *E. laticeps* is definitely larger than *fasciatus* at hatching and may be as much as 4.9 mm. longer in head and body length. The number of scales around the body in *laticeps* average greater than in *fasciatus.* The postlabials are well developed and quite evident in *fasciatus,* but nearly or completely obscured in *laticeps.* The secondary temporal is enclosed in a different manner in the two species. Young *laticeps* show 7 lines, while young *fasciatus* have only 5. The supralabial character appears to be by no means reliable, although the percentage of specimens of *laticeps* having 8 supralabials on either or both sides is larger than in *fasciatus.* It is obvious that much confusion will result if this character is relied upon. The infralabials, prefrontals, and subdigital lamellae are not diagnostic in the present material.

A comparison of the mothers of these broods with each other and with the young is also interesting. The female *laticeps* measures 97 mm. from snout to vent, while the four *fasciatus* measure 64, 60, 62, and 59 mm. The latter individual is the St. Mary's County specimen and laid only three eggs. The *laticeps* has 32 scales around the body, the *fasciatus* have 30. The female *laticeps* has eight supralabials on the right and 7½ on the left (fourth not full-sized), while all the *fasciatus* have 7 on both sides. The postlabials and secondary temporal characters are the same in the adults as in the young.

The prefrontals are in contact in all except the *fasciatus* from St. Mary's County, the young of which have the prefrontals respectively barely touching, in moderate contact, and broadly in contact. The seven-lined condition of the young *laticeps* persists, though not so markedly, in the adult female. The sublateral lines appear as obscure light lines sharply dividing the dark ground color of the dorsum from the lighter color of the venter, while in *fasciatus* these ground colors blend or are not so sharply separated in this region.

It should be noted in conclusion that the characters described here for *Eumeces laticeps* correspond to those mentioned by Taylor (1935) for eastern specimens of the species. I have found it very easy, using these characters, to discriminate between Maryland specimens of *laticeps* and *fasciatus* of all ages.

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DEPARTMENT OF ZOOLOGY, CORNELL UNIVERSITY, ITHACA, NEW YORK.

Development of the Frontoparietal Bones in Frogs

By THEODORE H. EATON, JR.

IN W. K. Parker's description of the development of the frog skull (1871), the origin of the "frontoparietal" bones was incorrectly interpreted. Since that time his error has been repeated by nearly all writers on the subject. This is true, for example, even in Gaupp, Ecker, and Wiedersheim's monumental "Anatomie des Frosches" (part 1, p. 50). Parker stated that each frontoparietal begins as two separate pieces which subsequently fuse. He thought the anterior piece was the frontal and the posterior the parietal; hence the compound name for the resulting bone on each side. But an examination of young and transforming tadpoles of *Rana clamitans, Hyla regilla, Bufo californicus* and *Scaphiopus hammondii* shows that in none of these are there separate anterior and posterior elements at any stage. The frontoparietals begin as single sliver-like units, not in the least resembling Parker's figures.

Figure 1 A, of a half-grown tadpole of *Rana clamitans,* shows an early stage in the formation of these bones, at a time when no other membrane bones are present. They lie on either side of the median line, over the brain,

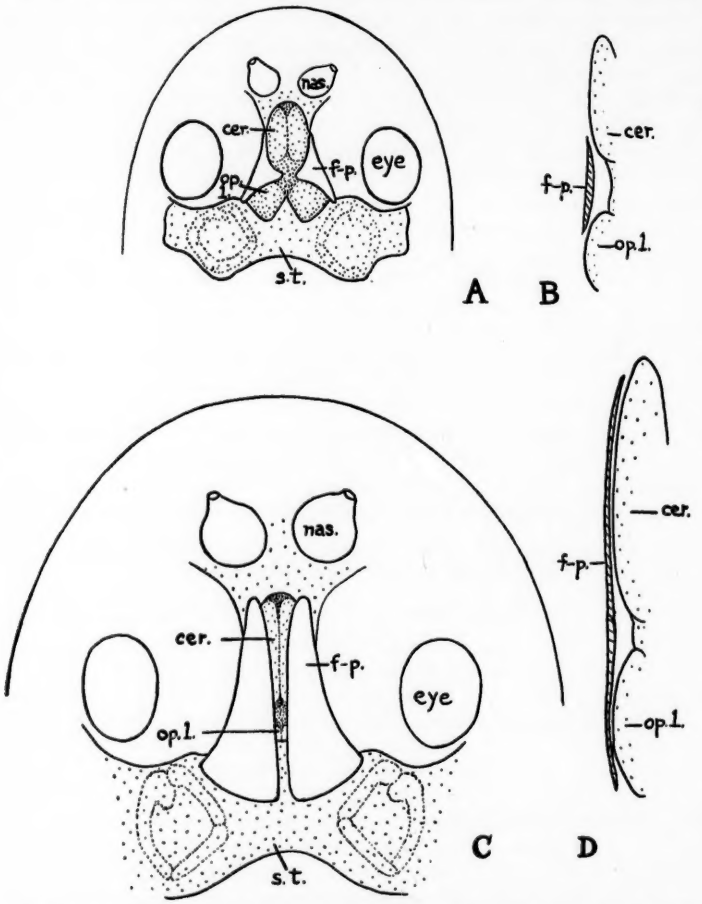

Fig. 1, A. Cranium of half-grown tadpole of *Rana clamitans,* dorsal view. B. Parasagittal section of A, showing frontoparietal in relation to brain. C. Cranium of transforming tadpole of *R. clamitans,* dorsal view. D. Parasagittal view of C, showing frontoparietal in relation to brain.

cer., cerebral hemisphere; *f-p.,* frontoparietal; *nas.,* nasal capsule; *op. l.,* optic lobe; *s. t.,* synotic tectum.

partly roofing the depression between the cerebral hemispheres and the optic lobes (fig. 1 B). The otic capsules and synotic tectum are cartilaginous and are largely behind the optic lobes. In a later larva of the same species,

at early metamorphosis (legs 12 mm. long), the synotic tectum extends farther forward (fig. 1 C). The frontoparietals have grown backward partly over the cartilage, and also reach forward to the anterior end of the cerebral hemispheres.

At this stage each frontoparietal shows an adjustment of its shape to that of the brain (fig. 1 D). The posterior third is slightly convex, fitting over the optic lobe, and the anterior half likewise bulges upward a trifle, over the cerebral hemisphere. This apparently accounts for Parker's mistake, since when light reflects from the wet surface of these bones during dissection it looks as if each were formed of two separate pieces, of the same proportions as shown in his figure.

The present work does not establish the real homology of the single pair of existing bones. That probably cannot be done until fossil ancestors of existing Salientia are discovered which show either the loss of parietals, the loss of frontals, or an ancient fusion of the two which took place so early that there is no longer any sign of its occurrence in ontogeny. Until then it may be as well to continue using the familiar term "frontoparietal," remembering that it has no justification in development.[1]

Professor Robert Broom, the South African paleontologist, suggested this inquiry in a lecture during his 1937 visit to the United States, and credit for the idea should consequently be his.

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Union College, Schenectady, New York.

A New Bromeliad Frog

By Edward H. Taylor

While collecting at night with Radclyffe Roberts in the neighborhood of Tianguistengo, Hidalgo, Mexico, I came upon a small frog in a meadow which was recognized as a new *Hyla*. The following day, accompanied by Mrs. Roberts, I visited the locality again in the hope of finding other specimens. A few scattered trees with bromelias were noted and at Mrs. Roberts' suggestion these were investigated. The first plant taken from a branch at an elevation of about 6 meters contained a specimen of the new *Hyla* and a new species of *Oedipus*. With this beginning, the supply of plants in this vicinity was exhausted, the lot yielding two more specimens of the *Hyla* and a second specimen of the *Oedipus*. In another nearby locality, in

[1] J. Piveteau (*Annals de Paleontologie*, 26: 1-46, 1937) describes a lower Triassic frog from Madagascar, the oldest known, in which no suture occurs between frontals and parietals. It is possible, however, that one or two modern types may still have them separate at first appearance.

low hardwood forest, more bromelias were found and in some two hundred plants we obtained a good series of the *Oedipus* but no other specimens of *Hyla* save a single large *Hyla baudinii*.

Hyla ***bromeliana,*** sp. nov.

TYPE.—EHT–HMS No. 16630, collected near Tianguistengo, Hidalgo, Mexico, in bromelias, Aug. 11, 1938, by Mrs. Hazel Roberts and E. H. Taylor.

PARATYPES.—EHT–HMS Nos. 16628, 16629, 16631. Same locality, Aug. 10–11, 1938. Collectors, Mr. and Mrs. Radclyffe Roberts, and E. H. Taylor.

DIAGNOSIS.—A small species (known maximum length 29.5 mm.), with reduced vomerine teeth; tongue not free posteriorly; no vocal sac; choanae large; fingers about one-third webbed; toes three-fourths webbed; tibio-tarsal articulation extending to tip of snout; eyes large, protruding; tympanum distinct, about one-half the diameter of the eye; first finger apparently opposable; limbs definitely barred; back and sides spotted black.

DESCRIPTION OF TYPE.—A small frog with a large head and rather narrow body; vomerine teeth in two low groups, between the large choanae, each group as wide as, or a little wider than, its distance from the choana, larger than the distance between them; mucous pores opening into a nearly straight groove which is midway between anterior part of mouth and the choanae; eustachian openings small; tongue large, not free posteriorly, not nicked behind and not or scarcely emarginate; areas about nostrils strongly elevated, with a broad depression between; canthus rostralis moderately sharp, the lores distinctly concave, then sloping somewhat to lip; distance of nostril from eye equals its distance from median point on edge of lip; snout projecting slightly (1.1 mm.) beyond mouth; eye prominent, strongly elevated, the width of an eyelid (3 mm.) a little less than the interorbital distance (3.25 mm.); distance between nostrils 3.3 mm.; diameter of tympanum (2 mm.) more than half the length of eye (3.5 mm.); distance between tympanum and eye 2 mm.; head about as wide as long (9.8 x 10 mm.).

Fingers webbed for about one-third (or slightly less) of their length, the tips strongly dilated, the widest pad 1.9 mm.; subarticular tubercles of variable size, that on outer finger not bifid; a very narrow elongate pad on the widened base of the thumb; large palmar tubercle completely divided into five sections; many supernumerary tubercles on palm; a more or less continuous fold on underside of fore part of arm; leg long, slender, the tibiotarsal articulation reaching to the tip of the snout; when legs are folded at right angles to the body the heels overlap; toes from one-half to three-fourths webbed, the membrane reaching the pads as very narrow fringes; the inner metatarsal tubercle contained in its distance from the tip of first finger 2.5 times; the outer tubercle small, rounded, lying farther forward than inner; a tarsal fold extends from the inner tubercle to heel; skin above minutely corrugated, rougher on the posterior part of body, smoother on the limbs; chin with a few granular tubercles, abdomen and breast granulate, the granules irregular in size; more than half of the ventral surface of femur granulate; a few granules near anus on posterior face of femur; anal flap large, elongated

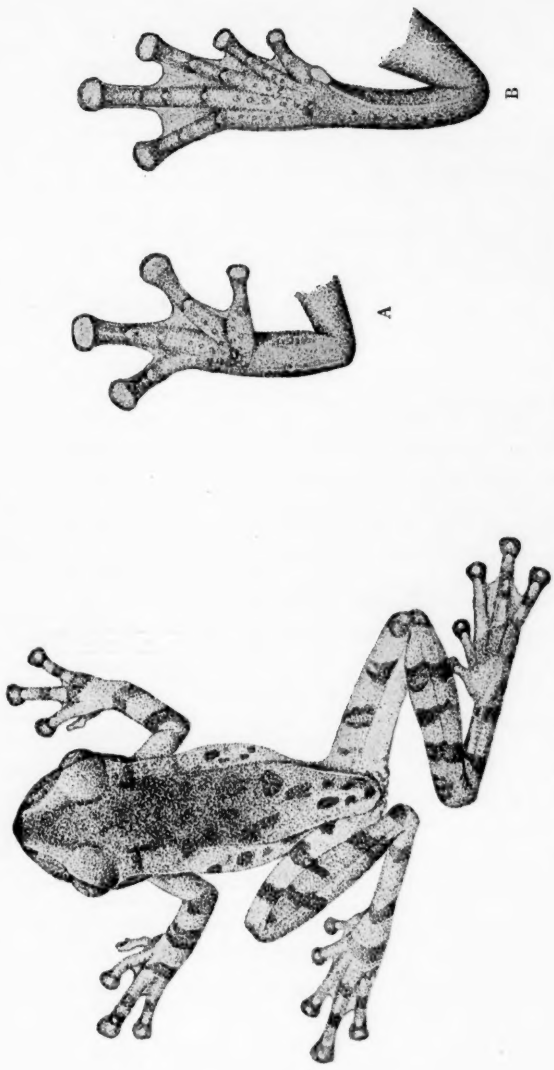

Fig. 1. Dorsal view of type of *Hyla bromeliana*, sp. nov., x2. A Ventral surface of hand, x3. B. Ventral surface of foot, x2.

to near the level of ventral surface of femur followed by a groove, the flap fluted or tuberculate; a rather thickened fold from eye to foreleg, covering upper edge of the tympanum.

COLOR IN LIFE.—Lavender-gray above with scattered blackish-gray spots; limbs barred with dark gray on a yellowish olive-gray ground color; sides yellow-cream becoming canary-yellow in groin, with a slight trace of cream; sides with a few black spots or reticulations; below lemon-yellow, the chin more yellow than cream; in region below eye the lip is white with darker markings, the color continued on lip to tip of snout but not so well contrasted anteriorly; a scattering of pigment on edge of chin and on underside of hand and foot; anal flap largely white.

MEASUREMENTS OF TYPE AND PARATYPES (IN MM.).—Nos. 16630, 16628, 16629, 16631; sex, ♂, ♂, ♂, ♀; snout to vent, 28.5, 29.5, 26.2, 25; length of snout, 4.7, 4.5, 4.7, 4.2; width of head, 10.3, 10.5, 10.4, 9.3; length of head, 10, 10, 9.8, 8.3; arm, 18, 19, 17.5, 13.5; leg, 44, 47.2, 42, 38; tibia, 15, 16.5, 14, 13; foot, 20.5, 21.3, 19, 17.1.

VARIATION.—The color noted on the living specimens varies somewhat; No. 16628 is like the type, save that the chin and throat are yellow-cream; feet yellowish below; eye bluish. No. 16631, like type but spots on the back faint as are the bars on the legs; chin and throat cream; abdomen and undersides of limbs lemon yellow. No. 16629, like type, but with some spots on back confluent, the bars faint on the legs; chin cream, with olive spots; a few scattered cream flecks on the lemon-yellow of abdomen. In No. 16631 the tibiotarsal articulation reaches slightly beyond eye; and the tympanum is less than half the diameter of the eye. The vomerine teeth vary, and are more or less indistinct in the smaller specimens.

The three males all lack any trace of asperities on the thumb; the vocal sac is absent.

REMARKS.—This form bears a superficial resemblance to *Hyla pinorum* Taylor but the snout is longer, the tympanum is present, the subarticular tubercle of the outer finger is undivided, the anal flap is greatly elongated, the tongue is not free posteriorly and not notched behind. In *H. pinorum* the digital membranes are fleshy and more or less granular or tubercular. The choanae in *pinorum* are distinctly larger and the vomerine teeth are in smaller, higher groups. As the type of *pinorum* is a female it is not known whether the vocal sac is present or not in males. I strongly suspect that *H. pinorum* may likewise inhabit bromelias.

I found no eggs or tadpoles of the new form and cannot be certain that the eggs are deposited in the water contained in the plants in which it hides.

DEPARTMENT OF ZOOLOGY, UNIVERSITY OF KANSAS, LAWRENCE, KANSAS.

Records of Amphibians and Reptiles from Oregon

By William Graf, Stanley G. Jewett, Jr. and Kenneth L. Gordon

RECORDS of reptiles and amphibians new to the Oregon list and additional records of rare forms have come to light in the course of our collecting during the past 7 years. Many of our records extend the ranges of old and well known species, and occasionally show them to be present in entirely new and unexpected places. Our collecting has been confined to a large extent to the region west of the summit of the Cascade Mts., though one of us (Jewett) has collected east of the Cascades as well as in the western region. The Cascade region is one of the most promising fields for collecting. This is borne out by the fact that within the time covered by our work a new species and one new genus have been found in this region. A systematic and thorough account of ranges and habits of our amphibians and reptiles is much to be desired. The nomenclature of the *Check List of North American Amphibians and Reptiles* (3rd ed.) is followed throughout, except for forms described since its appearance.

List of Species

Ambystoma gracile (Baird).—One taken Nov. 1, above Government Camp on Mt. Hood, under a wet log in a fir grove; another near Portland, Mar. 13; *gracile* is also recorded from Estacada, Jennings Lodge, and from 9 miles southeast of Sandy, Clackamas County; from near Corvallis, Benton County; Coquille, Coos County; and near Independence, Marion County.

Ambystoma macrodactylum Baird.—Three larvae taken on Sauvies Island near Portland, Aug. 2; an adult from Corvallis, Benton County.

Dicamptodon ensatus (Eschscholtz).—The larval form up to 250 mm. in length is common throughout most of western Oregon, but the adult form is rarely taken, particularly in the northern half of western Oregon. It is possible that *Dicamptodon* breeds in the larval stage in this region. Larvae with fully developed sex organs have been taken, the eggs of the females apparently fully matured and ready for laying at the time the specimens were collected; a large specimen of the larval form was seen in Bolin Lake, Josephine County, Aug. 18; and larvae were collected in Eagle Creek, Multnomah County, and in a small stream on Mary's Peak in Benton County, Oct. 25.

Two adults were taken near Portland, one on Oct. 25, and the other on March 13. Two more were caught in a small tributary creek of Fall Creek on the west side of Grass Mountain, Lincoln County, on July 19, during the height of a heat wave when the ground was very dry. This small stream was almost lost among the rocks, and the specimens were under and among the larger boulders, taking refuge in the pools when disturbed; after a minute or two they would appear at the edge of the pool with only their noses showing. They were at least partly submerged while hiding under the rocks. The stream was very heavily overhung with vine maple and could be worked only on hands and knees. Ten larval specimens in various stages of transformation were also captured, some being almost transformed. More collecting for mature *Dicamptodon* should be done during the hottest part of the summer in the small tributary streams well up near their source.

The first *Dicamptodon* taken in the Cascade range in Oregon was a 250 mm. larva, caught on hook and line in June, in the middle Santiam River about six miles above Foster, Linn County; the species was again recorded from the same region in 1935, and was later found to be very common in the small streams in the part of Linn County in the Cascades.

Rhyacotriton olympicus (Gaige).—Twenty-four specimens taken on Mary's Peak, Benton County, Oct. 25; several from a small tributary of Nash Lake, Lincoln County, Nov. 1; ten collected Apr. 19, 10 miles above Hoskins on Luckiamute River, Polk County; several from the Middle Santiam River above Foster, Linn County, collected Apr. 24. This salamander was common on the small tributaries of Fall Creek on the west side of Grass Mountain, Lincoln County, July 20; it was as abundant as *P. vehiculus* and *D. ensatus* in this area.

Plethodon dunni Bishop.—Our records are from near Portland, Oct. 24; Nash Lake and Estacada, both in Clackamas County; Mary's Peak, Benton County; 10 miles above Hoskins on the Luckiamute River, Polk County, Apr. 19; above the Fernwood Forest Camp on the South Santiam Highway and on the Middle Santiam River in Linn County; on Fall Creek, and above Bull Run Creek near Paradise Flats in Lincoln County, July 18.

Plethodon vehiculus Cooper.—No new records of the distribution of this salamander have been uncovered by the present work. It is one of the commonest salamanders in the humid coniferous forest of the northwest and may be found anywhere that these forests are found. It has, so far as is known, never been taken in the valley, and is apparently confined to the west slope of the Cascade Mountains and to the Coast Range Mountains of northwestern Oregon. Our southernmost records are Fernwood Forest Camp, Linn County, and Fall Creek, Lincoln County.

Plethopsis wrighti Bishop.—*Plethopsis* was described from specimens collected nine miles southeast of Sandy on the Mt. Hood Highway, June 15, 1936. It was as abundant on the Middle Santiam River five miles above Foster, Linn County on Apr. 24, 1938, as *P. dunni* and *P. vehiculus*.

Ensatina eschscholtzii Gray.—One taken near Peoria, December, and one 15 miles east of Cascadia on the South Santiam Highway, July 10, several from the Middle Santiam River 5 miles above Foster, Apr. 24, all in Linn County; eight collected Dec. 31, east of Independence in Marion County.

Aneides ferreus Cope.—One from 9 miles southeast of Sandy on the Mt. Hood Highway in Clackamas County; one from above the Fernwood Forest Camp on the South Santiam Highway in Linn County.

Ascaphus truei Stejneger.—An adult was found July 18, in a mouse trap set at the edge of a small stream flowing out of Bolin Lake, Josephine County; three larvae from a small stream on Mary's Peak in Benton County, Oct. 25; a series of 33 larvae, 7 near-adult specimens with larval tails still present, and two adults from near the Lick Creek Ranger Station in Wallowa County, Aug. 15; two larvae and three adults from the small tributary of Fall Creek in Lincoln County where the adult *Dicamptodon* were taken, July 20.

Scaphiopus hammondii Baird.—A series from Frenchglen, Harney County, May 19, was collected by S. G. Jewett, Sr.; numerous specimens from Buena Vista, Harney County, July 8 to 10.

Bufo boreas boreas (Baird and Girard).—Larvae present in Fish Lake in the Steens Mountains, Harney County, in June; one from near Davis Lake in the Cascade Mts., Deschutes County, June 17; mature toads common around Clear Lake, Fish Lake, and Big Lake, Linn County. Big Lake is at an elevation of 4645 feet. The transformed young swarmed along the edge of Diamond Lake, Douglas County, Sept. 22.

Hyla regilla Baird and Girard.—Taken at Wildwood Camp, on the Ochoco Highway, Wheeler County, June; others from Fish Lake and Big Lake, Linn County, July 28.

Rana boylii boylii (Baird).—Several from Pistol River, Curry County, July 10–11; Middle Santiam River above Foster, Linn County; common on the Middle Santiam River at a point about ¼ mile above the junction of the Middle Santiam and the South Santiam Rivers, where they fairly swarmed in the small pools formed by a spring seepage, on Apr. 24.

Rana catesbeiana Shaw.—Very common at Oswego, Clackamas County; one taken at Oswego in June, was found to contain the remains of a ring-neck snake (*Diadophis amabilis occidentalis*). Known to occur on the Willamette River at Salem, Independence, and Albany; also common in Colorado Lake, and in the Calapooya River, west of Shedd, in Linn County.

Rana pretiosa luteiventris Thompson.—Two from Marks Creek, Ochoco National Park; several from Crater Lake and in the Blitzen River Valley, Harney County; others from Mountain Creek, a tributary of the John Day River, Grant County, August; one from 8 miles above Belknap on the McKenzie River, July 26; two from Ice Cap Springs, and ten from Clear Lake, all in Linn County. Distinct intergradation with *pretiosa* appears to the westward of Cascade divide, notably at about one-third of the way down from the summit on the west side, on the South Santiam Highway.

Crotaphytus collaris baileyi (Stejneger).—Two collected by S. G. Jewett, Sr., 16 miles south of Adrian, Malheur County, May 28; also seen near Rome, Malheur County.

Crotaphytus wislizenii Baird and Girard.—Two from 16 miles south of Adrian, Malheur County, May 28, taken by S. G. Jewett, Sr.; one seen near Rome, Malheur County, in July.

Uta stansburiana stansburiana (Baird and Girard).—Near Maupin and on the Deschutes River, Wasco County; Blitzen River Valley in Harney County; four taken near Cecil, Morrow County, Apr. 8; several from Frenchglen.

Phrynosoma platyrhinos Girard.—Near Rome, Malheur County; Catlow Valley, Harney County.

Phrynosoma douglassii douglassii (Bell).—Thirteen specimens from Sand Mountain, Linn County, at an elevation of 5560 feet, Aug. 15, all taken in less than ¼ mile walk around the rim of Sand Mt. crater. Three sizes are represented, small ones 12-18 mm. in length, intermediate specimens 35-45 mm., and what is apparently the mature form, measuring 56-58 mm.

Sand Mt. is one of a number of small extinct craters just north of the Belknap Lava Flow. The tops of these mountains are almost bare of vegetation other than a few scattered manzanita and chaparall bushes and an occasional white-bark pine. The ground consists of fine volcanic rock, almost sand-like in places and quite coarse in others. Horned lizards were found near the shrubs or low-growing pines and could be detected only when they made a dash for these retreats. There was an abundance of ants, beetles, bugs, wasps, and flies; examination of fecal pellets showed that all these insects were being taken by the lizards.

Gerrhonotus principis (Baird and Girard).—Neahkahnie Mt., Tillamook County; on the Luckiamute River 9 miles above Hoskins, Polk County; Portland, and Eagle Creek, Multnomah County.

Gerrhonotus scincicauda scincicauda (Skilton).—Common near Corvallis, Benton County; Brownsville, Linn County; Portland, Multnomah County; and near Maupin, Wasco County.

Cnemidophorus tessellatus tessellatus (Say).— One specimen 16 miles south of Adrian, Malheur County, May 28, by S. G. Jewett, Sr.

Eumeces skiltonianus (Baird and Girard).—Common west and south of Brownsville, Linn County; taken on the Middle Santiam River above Foster, Linn County; 12 miles south of Port Orford, and on the Winchuck River, both in Curry County; Selma, Jackson County; Sisters, Deschutes County; and near Silver Creek Falls, Marion County.

Charina bottae (Blainville).—Common in the hills near Corvallis, Benton County; collected on Eagle Creek, Clackamas County; near Elgin, Union County.

Diadophis amabilis occidentalis Blanchard.—Common at Corvallis, Benton County; a specimen from Sutherlin, Douglas County; one taken from the stomach of a bull frog collected at Oswego Lake, Clackamas County; one from Peterson Butte, Linn County.

Coluber constrictor mormon (Baird and Girard).—One specimen from Jennings Lodge, Clackamas County; Frenchglen and Catlow Valley, Harney County; common near Corvallis, Benton County; and from Peoria, Linn County.

Coluber taeniatus taeniatus (Hallowell).—Collected in the Blitzen River Valley, Harney County.

Pituophis catenifer deserticola Stejneger.—Blitzen River Valley, Harney County; Langell Valley, 6 miles north of the California-Oregon state line, Klamath County.

Contia tenuis (Baird and Girard).—Common west of Corvallis, Benton County.

Thamnophis sirtalis infernalis (Blaineville).—Just south of Grants Pass, Curry County; Paulina Mts., Crook County.

Crotalus viridis oreganus (Holbrook).—There seem to be no records of rattlesnakes in the western part of the state north of Peterson Butte, Linn County. Their western limit in the Willamette Valley is Saddle Butte, near Shedd, Linn County, and Springfield (reported by reliable observers) west of Eugene, Lane County. Investigation brought out the fact that rattlesnakes had at one time been very common in the butte country along the western foothills of the Cascades, though now much reduced in numbers. *C. v. oreganus* was found to be the most common snake in the Brownsville area, except perhaps for the garter-snakes. Three were taken in 1938 from a "denning ground" where we were assured that ninety-seven had been killed during April of 1936, and twenty-seven in 1937. Shed skins were plentiful around brush and rock piles, but the snakes proved to be elusive on numerous collecting trips into this area. It was reported that a road crew, while blasting a rock ledge early in the spring of 1935, had killed over 100 rattlesnakes. Rattlesnakes are also present in the foothills about 3 miles southeast of Monrow, Benton County, in a region quite similar to the Cascade region described. The Corvallis newspaper reported the killing of a rattlesnake on Baldy Hill, 2 miles west of Corvallis, in the spring of 1938.

Clemmys marmorata (Baird and Girard).—Collected near Jennings Lodge, Clackamas County, by Wm. L. Finley, June 3; common on the Willamette River and its tributaries at least as far north as Salem; very common in the sluggish streams and ponds of Benton, Lane and Linn counties. Egg laying has been observed during the first two weeks of June in Linn County near Peoria.

Chrysemys bellii bellii (Gray).—Taken on Sauvies Island, near Portland; more abundant on the Columbia River and near the mouth of the Willamette River than *Clemmys marmorata,* which is the prevailing form farther south.

DEPARTMENT OF ZOOLOGY, OREGON STATE COLLEGE, CORVALLIS, OREGON.

Herpetological Notes

NOTES ON THE SALIENTIA OF THE GASPÉ PENINSULA.—Trapido and Clausen have recently (1938, COPEIA: 117) reviewed the literature and given many records on the occurrence of amphibians in eastern Quebec. Aided by a grant from the Department of Zoology, Columbia University, we collected near Cascapedia, P. Q., during September, 1938. All the frogs and toads listed for Gaspé by the above authors were found, but in several instances their records do not give a true picture of the relative abundance of the species.

Although *Rana septentrionalis* was not collected by Trapido and Clausen, we found it on numerous occasions. It was one of the more common forms around Cascapedia and occurred in meadow swamps, bogs, pools, and roadside puddles.

Rana palustris, which they likewise failed to collect, was the most common and widely distributed frog in the Cascapedia region. Specimens were taken from wet meadowland, upland fields, woods, ponds, and along streams. *Rana pipiens* was also very common but restricted to wet meadowland. *Rana clamitans* was common in both large and small pools.

A third species, *Hyla crucifer,* not obtained by Trapido and Clausen, was found to be common and generally distributed.—JOHN MOORE AND BETTY MOORE, *Department of Zoology, Columbia University, New York City.*

NOTES ON THE YELLOW-LIPPED SNAKE.—The references to the habits of *Rhadinaea flavilata* pertain, so far as we know, only to the habitat. Coues and Yarrow (1878, Proc. Acad. Nat. Sci. Phila.: 26) mention finding the type specimen near marshy ground on Bogue banks south of Fort Macon, North Carolina, and state that later at the same place another specimen escaped by entering the water. Schmidt (1916, J. Mitchell Sci. Soc., 32: 37) records one specimen from beneath "a pine log near Councils (Blanden County)," North Carolina. Löding (1922, Mus. Papers, Ala. Mus. Nat. Hist., 5: 32) said of it in Alabama, "Not uncommon in low cut-over pine lands under logs in early spring." In Mississippi, Allen (1932, Amer. Mus. Novit., 542: 14) found two beneath the bark of pine stumps in March and a third one about a month later under a pile of straw. Ditmars (1936, The Reptiles of North America: 269) says only, "It is secretive and may be found under the bark of decaying logs."

Dr. H. K. Gloyd mentions in a letter finding a specimen at Sun, St. Tammany Parish, Louisiana, "among loose bark, leaves, and other debris on one of the alluvial ridges between the swamps."

In the vicinity of Lake Worth, North Palm Beach County, Florida, *Rhadinaea* has been collected in quartz sand country as well as in regions of muck or black dirt, but when in the sand as damp a position as possible was selected. The choice of hiding places was found to be much as the literature suggests. For example, one was found on damp ground under a piece of metal and another beneath a charred stump near a small canal on a truck farm.

A captive specimen kept for some time ate a considerable number of *Microhyla carolinensis*. This food record and the data on the habitat correlate interestingly, for Wright and Wright (1933, Handbook of Frogs and Toads: 194) say of the narrow-mouthed frog: "Nocturnal, a lover of rain, cover and moist situations. It is a subterranean species. Hides in decaying logs or beneath them or under haycocks or other shelter."

The specimen mentioned above was found under a log near the South Lake Worth road, west of Lake Worth. It was a male with a total length of 325 mm., tail length 107 mm.; ventrals 129, caudals 75, supralabials 7, infralabials 9, oculars 1-2, temporals 1-2-3. The darker reddish-brown of the head extended over the 3 scale rows back of the parietal scutes. The skeleton is preserved in the collection of the junior author.—GEORGE R. CAMPBELL, *Lake Worth, Florida,* and WILLIAM H. STICKEL, *University of Michigan, Ann Arbor, Michigan.*

ADDITIONAL DATA ON JAMAICAN SNAKES OF THE GENUS *DROMICUS*.—Since the appearance of my note "The Jamaican *Dromicus funereus* (Cope) Re-established" in a recent number of COPEIA, I passed through Jamaica to collect on the Cayman Islands and secured sufficient additional material to add some interesting data on *Dromicus*. The article in question was open to the criticism that the sexes were not distinguished in the table and it therefore was still a possibility that the long-tailed *callilaemus* might represent the males and the short-tailed *funereus* the females of a single species.

Eleven specimens of *funereus* from near Montego Bay were taken in a few hours under piles of cocoanut husks. They were in company with *Celestus occiduus* (Shaw), *Eleutherodactylus jamaicensis* Barbour, slugs, land crabs and yellow-and-black spiders. The *Celestus* were feeding on the slugs; the snakes and the spiders were preying on the frogs. The crabs were apparently the cause of the mutilation of the snake tails, which is shown in the table. The snakes were infested with ticks under their chins and anterior to the vent.

The revised table omits the number of scale rows, which are uniformly 19-17, except in male *callilaemus*, in which they are 19–16 in half the specimens; the upper labials are uniformly 7; the lower labials can be counted as 8 or 9 as it is a matter of interpretation as to what constitutes the last labial. The table clearly shows that the species are distinct and that each has an individual sexual difference expressed in proportional tail-length. *D. callilaemus* has 112-122 caudals in the males; 101-105 in females and average 113 for the species; *funereus* 79-91 in males; 75-79 in females and average 83.3 for the species. There is apparently no sexual significance in the number of

ventrals, but *callilaemus* averages 137.4 and *funereus* 132.8. The National Museum specimens are omitted since Dr. Cochran writes under date of August 5, 1938, that U.S.N.M. No. 5779 is not now in their collection and she hesitates to sex the others. No. 5779 was listed by Cope as having only 17 scale rows, but the writer doubts this record as it would be the only specimen with less than 19 rows. A very short row which makes the 19th can easily be overlooked. Dr. Stejneger questioned Cope's statement in a letter dated July 8, 1937.

MEASUREMENTS AND SCALE COUNTS OF *Dromicus funereus* AND *D. callilaemus* ASSORTED TO SEX

Serial No.	Sex	Length of body	Length of tail	Tail/Total length	Ventrals	Caudals	Caudals/Ventrals + Caudals	Locality
				Dromicus callilaemus				
420	♂	236	172	.42	139	115	.45	Hope Gardens
536	♂	219	158	.41	135	118	.46	Kingston
761	♂	152	110	.42	141	112	.44	Boston Bay
760	♂	132	90	.40	135	120	.47	Boston Bay
1150	♂	210	...	...	135	...	...	Kingston
1151	♂	210	153	.42	136	112	.45	Kingston
2001	♂	217	160	.42	141	122	.46	Hope Gardens
359	♀	207	135	.39	139	105	.43	Kingston
1149	♀	188	...	...	137	...	...	Kingston
2002	♀	218	136	.38	136	101	.42	Hope Gardens
				Dromicus funereus				
333	♂	221	119	.35	132	87	.39	Mandeville
1007	♂	211	110	.34	135	88	.38	Mandeville
332	♂	170	83	.32	133	84	.38	Mandeville
1177	♂	250	133	.34	133	81	.37	Mandeville
1178	♂	253	136	.34	132	84	.38	Mandeville
2069	♂	251	142	.36	133	91	.40	Port Maria
2070	♂	173	90	.34	138	87	.38	Port Maria
2279	♂	210	...	...	127	...	...	Montego Bay
2280	♂	190	...	...	132	...	...	Montego Bay
2281	♂	210	...	...	128	...	...	Montego Bay
2282	♂	187	95	.34	133	79	.36	Montego Bay
2283	♂	208	...	...	131	...	...	Montego Bay
2284	♂	218	...	...	134	...	...	Montego Bay
2286	♂	225	106	.32	133	81	.37	Montego Bay
2288	♂	101	47	.31	132	82	.38	Montego Bay
2289	♂	103	49	.32	130	83	.37	Montego Bay
239	♀	300	135	.31	136	78	.36	Bog Walk
240	♀	265	122	.31	136	79	.36	Bog Walk
1076	♀	168	72	.30	136	75	.35	Mandeville
2186	♀	242	...	...	134	...	...	Williamsfield
2285	♀	240	...	...	131	...	...	Montego Bay

CHAPMAN GRANT, *San Diego, California.*

AN EXTENSION OF THE RANGE OF *PLETHODON YONAHLOSSEE.*—In the third (1933) edition of Stejneger and Barbour's *Check List of Amphibians and Reptiles* the range of *Plethodon yonahlossee* is given as "wooded mountains near Linville, North Carolina, and in southwestern Virginia." To this should be added northeastern Tennessee. On two occasions (July, 1932, and June, 1935) *P. yonahlossee* has been taken in damp, deeply wooded ravines on Holston Mountain, Tennessee, in Sullivan County near the Johnson County line. Collections were made on the west slope of the mountain, along highway U. S. 421, at an estimated altitude of between 3000 and 4000 feet. *P. glutinosus* was found in the same localities with *P. yonahlossee,* in about equal numbers and often under the same log. In June, 1935, *P. yonahlossee* was found more abundantly in northeastern Tennessee than in the type locality. In one ravine two of us collected ten specimens in less than half an hour. On a trip to the same localities in late October, 1938, following freezing weather, no specimens of either *P. glutinosus* or *P. yonahlossee* were found.—I. E. GRAY, *Zoology Department, Duke University, Durham, North Carolina.*

DISPOSITION IN THE BOX-TURTLE.—A statistical study of the box-turtle, *Terrapene carolina* (Linnaeus) at Mastic, Long Island, by marking individual turtles, brings out some interesting points about the disposition of this animal.

Some box-turtles close themselves up in their shells when disturbed, and are reluctant to open up, deliberate and cautious about pushing out their heads and legs again. Others struggle continuously to escape with legs and necks extended and can scarcely be induced to close up at all. There is every gradation between these extremes of temperament. Females tend toward the former, males toward the latter, but this is one of the least constant and reliable sex differences.

Where a turtle's temperament was markedly one or the other of these types, the fact was recorded, and there are 24 turtles with the record repeated in succeeding years, showing that this temperament peculiarity usually persists for the individual.

In two only out of the 24 is there a definite reversal. A male recorded as "retiring" was recorded as "bold" 7 years later. A female recorded as "retiring" was "bold and somewhat restless" 5 years later.

On the other hand 18 turtles, of which 6 were males, 5 were females, and 7 not certainly determined, were recorded more than once as bold or restless over varying periods as follows:

JN-16-18, period 5 years, 3 times
JN-17-3, period 1 year, 2 times
JN-18-4, period 1 year, 2 times
JN-18-13, period 13 years, 4 times
JN-19-8, period 8 years, 3 times
JN-23-1, period 3 years, 3 times
JN-23-13, period 3 years, 2 times
JN-24-35, period 1 year, 2 times
JN-26-9, period 1 year, 2 times
JN-27-9, period 5 years, 2 times
JN-27-17, period 2 years, 2 times
JN-29-12, period 5 years, 2 times
JN-29-13, period 4 years, 2 times
JN-29-32, period 4 years, 3 times
JN-32-6, period 1 year, 2 times
JN-32-21, period 1 year, 2 times
JN-33-17, period 3 years, 2 times
JN-34-41, period 2 years, 2 times

Nos. JN-29-13 and JN-27-17, show that this character may persist from youth to maturer size. The first of these showed it when its plastron was flat, 3⅝ inches long, with 5 rings, and 4 years later when its plastron was slightly concave, 4⅝ inches long, with 9 rings. Presumably this was a male though counted with the not certainly determinable. No. JN-27-17, noted as "bold and restless" when its plastron was slightly concave, 4⅝ inches long, with 11 rings, and also 2 years later with plastron definitely concave, 4¾ inches long, with 12 rings, was a male; and it seems probable and in line with such other data as there is that both were young males normally reaching maturity at around 12 or 14 years and 4¾ inches.

Four turtles, of which one was a male, 2 females, and one not certainly determinable, were recorded more than once as retiring or the equivalent as follows:

JN-17-31, period 15 years, 4 times
JN-24-22, period 5 years, 2 times
JN-25-48, period 12 years, 2 times
JN-33-58, period 3 years, 2 times

In considering these figures it may be borne in mind that a particularly bold and restless turtle, which was a nuisance to handle, was considerably more likely to be recorded as such, than one that was unusually retiring.—J. T. NICHOLS, *New York City*.

A NOTE ON *ELEUTHERODACTYLUS RICORDII*.—Some five years ago my attention was attracted by a trilling sound which seemed to come from a cluster of ferns about a palm. At first I thought it was some new cricket or grasshopper, but very careful search and watching did not solve the problem. Although I have lived in south Florida for forty years, I had not heard this trill before.

The following summer my daughter and I saw a small frog jump from one leaf to another of the clump. We caught it and found it to be an exceedingly active frog very different from the familiar hylas. Its rusty brown color closely resembled the color of its surroundings; its build was very slender; the nose was marked with a golden V-shaped bar. Further observation showed that it was this frog which made the musical note which had attracted my attention. In the past two years this frog has been more frequently observed; it proves to be nocturnal and terrestrial in habits.

Presuming that this frog, like others, laid its eggs in a lily pond near its habitat, I did not give any thought to the life cycle. While looking over some orchids which I had banked with spaghnum I found a cluster of what appeared to be frog or toad eggs. I had not seen eggs laid in this way before. In order to see what had laid them I lifted the cluster, together with the spaghnum on which they were deposited, and placed them in a glass bowl and covered the bowl with a sheet of glass.

It was easy to see that the eggs were normal, for the embryo could be seen moving in them. In about seven days the eggs had hatched, the jelly-like cases lying flattened out on the spaghnum. After very close inspection of the spaghnum through the glass I saw a tiny frog not as large as a house fly seated on the moss. Its appearance was exactly that of the mature frog I had previously found so I knew that it was the young of that frog. I have found many nests since then, all made on the ground or close to it, in damp, shady places.

Having occasion to request some information from the Smithsonian Institution on another subject I casually mentioned my experience; Dr. Leonhard Stejneger kindly identified the specimens and suggested publication of this note.—Geo. H. Skermer, *Tampa, Florida.*

REPTILES AND AMPHIBIANS FROM BARBADOS IN FIELD MUSEUM.—In drawing up a catalogue of the Lesser Antillean collections of amphibians and reptiles in Field Museum, undertaken at the request of Mr. Karl P. Schmidt, Curator of Reptiles, I find a small series of specimens from Barbados which it seems to be desirable to place on record. These specimens were collected and presented to Field Museum by Mr. Stuart J. Walpole, editor of the *American Field,* in 1935. The species are the following:

Bufo marinus, seven specimens, Nos. 21092-4.
Eleutherodactylus martinicensis, eleven specimens, No. 21095.
Hemidactylus mabouia, one specimen, No. 21096.
Anolis roquet extremus, four specimens, Nos. 21097-21100.
Gymnophthalmus laevicauda, four specimens, No. 21101.

Eleutherodactylus martinicensis and *Gymnophthalmus laevicauda* seem to be additions to the forms recorded from Barbados. The herpetological fauna of the island includes, in addition to the above list (according to Barbour's list of Antillean amphibians and reptiles, Bull. Mus. Comp. Zool., 82, 1937: 77-166):

Phyllodactylus spatulatus Cope
Kentropyx intermedius Gray
Leptotyphlops bilineata (Schlegel)
Dromicus perfuscus Cope

In the specimens of *Gymnophthalmus laevicauda* the scales around the middle of the body are 13 in all; dorsals from interparietal to base of tail 33; lamellae beneath fourth toe 14 or 15. The largest specimen has narrow but clearly developed dorsolateral lines extending a little beyond the insertion of the arm.—Robert A. Burton, *Evanston, Illinois.*

RECORDS OF THE SALAMANDER *TYPHLOTRITON.*—*Typhlotriton spelaeus* Stejneger has been reported from southwestern Missouri, northern Arkansas, and extreme southeastern Kansas. There seem to be no Oklahoma records with the exception of casual mention by Chase and Blair (1937, Amer. Midl. Nat., 18:220). The present records extend the range westward to what is probably the limit of distribution in that direction in view of the strict ecological restriction of the species.

Of the four locality records, two are from caves and two from springs. The thirty-seven specimens collected are all larvae. The records are as follows:

Bat Cave, 5 miles south of Kansas, Adair Co., Okla. This cave has a small entrance so that comparatively little light enters. The cave stream is rock bottomed, but empties upon a bed of guano and sinks into the ground just inside the entrance; *Typhlotriton* is restricted to the rocky part of the stream.
Dec. 27, 1935. Two larvae: 70.9, 63.5 mm.
July 10, 1936. Four larvae: 74.3, 63.6, 60.8, 19.6 mm.
July 14, 1936. Four larvae: 52.0, 50.9, 28.3, 24.7 mm.
Aug. 30, 1936. Six larvae: 75.2, 70.0, 55.4, 40.5, 35.2, 25.5 mm.
July 4, 1937. Four larvae: 77.5, 73.1, 72.9, 67.7 mm.
Aug. 7, 1937. Three larvae: 58.2, 41.0, 36.3 mm.
Aug. 19, 1937. Five larvae: 59.0, 53.7, 48.5, 38.0, 32.1 mm.
July 19, 1938. Two larvae: 79.0, 61.1 mm.

Spring Cave: a small cave, entirely rock bottomed, about ¼ mile from Bat Cave; the cave stream sinks into the ground just outside the entrance.
July 13, 1936. One larva: 18.9 mm.

Spring 5 miles south of Locust Grove, Mayes Co., Okla.
Mar. 6, 1936. One larva: 80.4 mm.

Spring at mouth of small cave 6 miles northeast of Tahlequah, Cherokee Co., Okla. The larvae from this locality are very noticeably darker than those from the other localities.
Aug. 19, 1937. Five larvae: 59.0, 53.7, 48.5, 38.0, 32.1 mm.

The author is indebted to Prof. H. D. Chase of the University of Tulsa and to his brother, P. F. Blair, Jr., for aid in collecting. The first individuals taken were identified

by Mr. Joseph E. Bailey of the University of Michigan; subsequently all have been checked with specimens from the type locality (Rock House Cave, Barry Co., Missouri). —ALBERT BLAIR, *University of Indiana, Bloomington, Indiana.*

MATING OF THE BOX-TURTLE ENDING IN DEATH TO THE MALE.—During the past five years the writer has walked about 1500 miles over all the slopes and ridges of Bull Run Mountain in Virginia in a study of the flora of the region. The common eastern box-turtle, *Terrapene carolina,* is very abundant here and is frequently met with throughout the woods and fields. During this period a number of dead turtles have been encountered, practically all males found lying upon their backs. In nearly every instance these specimens have been found in woodland, reposing upon soft beds of leafage. The specimens which died in the reversed position seem to have been unable to right themselves in the soft, yielding leaf debris. One may ask why the males more than the females should be subjected to the hazard of falling upon their backs. This is easily accounted for as the aftermath of a successful mating.

In successful copulation, at least in the last stages of the act, the male turtle will be found to have a nearly vertical position, or even to lean far backward. In this position there is an insertion of the male's legs between the plastron and carapace of the female, and her legs are sometimes locked in a strong grip around his to hold him in position. Following relaxation, the male, leaning far backward, withdraws his legs with her cooperation, and he invariably, it would seem, falls back upon his back. Should this happen in beds of soft, yielding leafage, he may never be able to right himself, and will die of weakness and starvation.

To right itself, the turtle extends its head as far outward and downward as possible to pivot its snout upon the earth. Then with a twisting movement, using its head as a lever, it throws itself over to the normal position, using the legs to assist this movement. But in loose and soft leafage and ground debris its head may fail to function as a fulcrum and lifting agent and the legs can get no grip upon anything solid, so that the poor creature is doomed to die a lingering death from starvation, while the female moves away with no further concern regarding its unfortunate mate.—H. A. ALLARD, *Washington, D. C.*

THE EFFECT OF *CONIOPHANES* POISONING IN MAN.—In April, 1936, the author was bitten between the second and third finger of the left hand by a 15 cm. specimen of an opisthoglyph snake, *Coniophanes imperialis.* The bite caused an itching and burning sensation in the region of the punctures. A short time later the two fingers became numb and swollen, and a red discoloration was noticeable. The slight pain decreased in a short time, though the fingers remained swollen for nearly three days. No treatment or especial attention was given to the bite.

An average sized *Coniophanes* was made to bite the author between the first and second fingers of the left hand on April 7, 1938. The short fangs, 2.5 mm. long, could be felt as they entered the flesh. Almost immediately there was a sharp pain resembling that of a bee sting. Although the snake attempted to chew, the fangs entered only once. Within an hour the pain had extended up the arm to the elbow. The hand gradually became numb, swollen, and practically useless. There was red discoloration of the hand, particularly around the punctures. The entire hand perspired profusely, and a small amount of amber-colored fluid exuded from both punctures. Five hours after being bitten the pain decreased and was noticeable only in the hand, which remained swollen and discolored. Twenty-four hours after the bite the general pain was gone, though the hand remained swollen and numb, with a slight soreness in the area of the punctures.

Three days after being bitten a slight swelling still remained and there was still some lameness in the muscles. In three weeks the fang marks had disappeared. The only other effect attributed to this experience was a nervousness, perhaps due to the uncertainty of the outcome.

Young specimens of *Coniophanes* occasionally attempt to bite, but adults (which average about 45 cm.) will not bite unless forced to do so.—BRYCE C. BROWN, *Harlingen, Texas.*

AMPHIBIAN RECORDS FROM NORTHWESTERN CALIFORNIA.—Three specimens of the Olympic salamander, *Rhyacotriton olympicus*, were collected by Mrs. Wood and myself along a small tributary of Wilson Creek, about 7 miles north of Klamath, Del Norte County, California, January 17, 1939. The salamanders were found, in company with *Dicamptodon* larvae and *Ascaphus truei*, under stones on small sand and leaf-mold beaches, along the margins of a tiny stream flowing through dense fir forest.

We collected a large series of adult and newly transformed *Rana aurora aurora* in April, 1933, just north of Klamath, Del Norte County. It was raining and frogs were abundant on the sopping forest floor. On subsequent examination one of the supposed red legged frogs turned out to be a female *Ascaphus*.

The day preceding this capture, while we were collecting *Dicamptodon* larvae in Prairie Creek, about 10 miles north of Orick, Humboldt County, a tadpole was seen adhering by the mouth to a large boulder in swift water; we were not fortunate enough to secure it, but noted the incident with the query, "*Ascaphus?*" We revisited this locality January 14, 1939, and collected four adult *Ascaphus*, and saw one tadpole, which we failed to secure. Two specimens were found under stones near the edge of the water. Two were found hopping in the open, among the stones on a little beach, one in the afternoon and the other at night. All these were taken within a space of 100 yards, and subsequent search of other beaches along Prairie Creek failed to yield specimens. Our sixth specimen of *Ascaphus* was taken in shallow water under a stone, along with the *Rhyacotriton* mentioned above.

Dicamptodon larvae are not uncommon along some of the Humboldt County streams, as in Prairie Creek, north of Orick. Ranger Milne, of Prairie Creek State Park, informs me that the adults frequently take the hook of fishermen.

After several years' collecting in northern California, we have just one locality for *Ambystoma paroticum*. This is a spot 2 miles north of Klamath, where adults are fairly common under logs and debris.

From San Francisco Bay to the Oregon line *Batrachoseps attenuatus attenuatus* and *Ensatina eschscholtzii* seem ubiquitous in all coastal localities suitable for salamanders. In the dense moist redwood forest *Ensatina* seems to become relatively more plentiful. *Aneides lugubris* and these two species are the most plentiful forms in the northern coastal area.

Aneides ferreus has been a very elusive form for me. Young individuals, which are usually distinguishable from young *lugubris* by the presence of red areas on the sides of the head and dorsal surfaces of the shoulders, thighs and tail, are not uncommon northward from southern Mendocino County. The juveniles are common, but adults are hard to find, generally occurring *in* rotten logs, and not under them as do most of the salamanders of the region. This species does not seem to enter the dense redwood forest, at least to any extent. The prevalence of arboreal habits in *ferreus* is not known, but might be the explanation of the creature's apparent scarcity.

At various central Mendocino County points *lugubris*, *ferreus* and *flavipunctatus* seem to occur together. My usual experience at such places has been to find juvenile *ferreus* associated with adults of the other two species.

Aneides flavipunctatus ranges northward from the Santa Cruz Mountains, its northern limits being uncertain. I have found it sparingly in the drier more southerly redwood areas, but it does not seem to enter the dense redwood forest of Humboldt and Del Norte counties. It inhabits the higher fir and pine forests of the outer coast ranges, and sometimes occurs in abundance in burned-over or grassy clearings and slopes. Many small individuals taken near Willits, Mendocino County, were characterized by a brilliant dorsal band of iridescent green. Two adults from this locality are unique, and may represent hybrids of this species with *lugubris*.

The distribution of *Plethodon elongatus* seems very localized. In repeated trips to the type locality, we found it only on a single small hillside area along the Klamath River. Recently Fitch (1936, Amer. Midl. Nat., 17: 638) reported this species from the Rogue River Valley in southern Oregon. In May, 1936, I found another small colony on a hill slope in logged-over redwood forest not far from Crescent City, California.—WALLACE F. WOOD, *Oakland, California.*

Ichthyological Notes

THE BREEDING HABITS OF *ICHTHYOMYZON GREELEYI* HUBBS AND TRAUTMAN.—Observations were made on the spawning of this recently described (Misc. Publ. Mus. Zool., Univ. Mich., 35, 1937:93-98) non-parasitic lamprey during May, 1935, in the Little Neshannock Creek near New Wilmington, Lawrence County, Pennsylvania. This small creek flows through an area of glacial drift and consists of alternating pools and moderate riffles from 20 to 30 feet wide with a bottom of sand, gravel and rubble. The flow was approximately 200 cubic feet per second during late May. Adults appeared in numbers about the middle of May, reached a spawning peak about May 24, and then died off rather quickly; and none were seen after June 1. Greeley (Suppl. Ann. Rept. N. Y. Cons. Dept., 27, 1928 (1929): 61) reports taking this species on May 25, and from lower French Creek in New York, and that "the breeding season was apparently finished at this date as no lampreys were found here a few days later."

The first adults taken in May on the spawning grounds were found under stones in riffles and under the overhanging sod along shore. Activity at this time consists in sporadic upstream movements. Individuals may occasionally be seen lying quietly in the current holding on to a stone by means of the buccal disk. When frightened they move rapidly for the cover of a rock or, more often, to the mud or overhanging sod near shore where they quickly bury themselves.

The spawning habitat is just above swift riffles and throughout slow to moderate riffles. Soon the males begin excavating a nest located, with but few exceptions, on the down stream side of a small, flat stone 6 to 12 inches in diameter. Pebbles are moved by grasping them one at a time with the buccal disk, swimming vigorously and dropping them a few inches away. Much fine silt floats away when the pebbles are moved, leaving finally a small cavity about 8 to 10 inches in diameter and 2 inches deep, with a bottom of sand and fine gravel. This cavity is situated partly under and downstream from the flat stone below which the nest was begun. During excavation the original male is joined by others who assist in nest building. One of these males would occasionally leave and start a new nest on the same riffle. The greatest activity in nest building, as well as spawning, took place in the afternoon, the high point being reached about 3 P.M. On two occasions lampreys were seen lying quietly in the nest at dusk, and perhaps they spent the night there.

Spawning was observed May 19 and every day through May 26. On May 24, when spawning appeared to be at its height, the water temperature was 18.8°C., the air 22°C. at 3 P.M. In one rather quiet stretch of riffle about 20 feet long and 4 to 8 inches deep, six different nests were observed, each containing from five to nine individuals. The breeding act was similar to that reported for other species of lampreys. The female, lying quietly grasping a stone, was seized on the rear of the head by a male and the eggs and sperm were released in the wild shaking which followed. The spawning of one pair would set the whole nest astir, the other males attempting to grasp a female and spawn. The final effect was the raising of considerable silt in which, on close examination, the very small eggs could be seen. These spawning acts were resumed at irregular intervals. Other fishes, especially *Campostoma anomalum anomalum*, were attracted by the spawning and would collect at the spot presumably to eat the eggs. Between spawnings a certain amount of nest building occurred, with the males removing pebbles. New individuals would occasionally join a spawning group and others would leave.

Many other species were spawning on May 24. *Moxostoma duquesnii, Notropis cornutus chrysocephalus* and *Notropis rubellus* were spawning in nearby riffles; a male *Hyborhynchus notatus* was guarding a group of eggs under a stone in quiet waters nearby; a male *Micropterus dolomieu* was guarding a nest at the side of a shallow pool and several completed nests of *Nocomis biguttatus* also were observed. Many dead specimens of *Campostoma a. anomalum* were found as is usually true after this fish has spawned.

By May 26 spent lampreys were captured floating aimlessly downstream and dead individuals were seen in pools below where spawning had taken place. Ultimately all of the spawning adults die.

Larvae were easily obtained below spawning areas by digging in the sand bars near shore and were usually to be found within 4 to 6 inches of the stream bottom in from 1 to 10 inches of water. On August 20, 1935, thirty-one larvae varying from 28 to 138 mm. in total length were taken. It appears that the young reach a length of from 28 to 35 mm. in their first summer. Adults measure from 110 to 155 mm. in total length at this locality.

Transformation from larva to adult appears to occur in the late fall or sometimes is completed in the spring. A fully transformed specimen was taken from the mud on March 23, 1935, in Big Sandy Creek near Franklin, Venango County, Pennsylvania. However, a specimen found under a stone in a rather swift flowing riffle on April 26, 1934, in the Neshannock Creek near New Castle, Pennsylvania, was not completely transformed.—EDWARD C. RANEY, *Zoological Laboratory, Cornell University, Ithaca, New. York.*

OBSERVATIONS ON THE NESTING HABITS OF *PAREXOGLOSSUM LAURAE* HUBBS AND TRAUTMAN.—Several casual observations made during June, 1938, indicate that the nesting habits of the chub minnow, *Parexoglossum laurae,* are similar to those of the cut-lips minnow, *Exoglossum maxillingua,* as reported by Van Duzer (COPEIA, 1939:00) and others.

On June 10, 1938, two pebble nests of *Parexoglossum laurae* were seen while seining in a shallow riffle of the Allegheny River, one mile north of Tionesta, Forest County, Pennsylvania. The first nest was situated under an old railroad tie which had become lodged just at the edge of a bed of water willow, *Dianthera americana,* about 5 feet from shore. It was roughly circular, about 1.5 feet in diameter, built up about 4 inches from the bottom, and consisted of small flat pebbles which average about 0.5 inch in diameter. The current was moderate and the water was 12 inches deep over the nest. Three males and two females were taken in the immediate vicinity. A careful search revealed another nest of approximately the same size, 10 feet from shore betwen two large stones, at a point 100 yards upstream. Many nests of the river chub, *Nocomis micropogon,* were observed in the vicinity. These nests were in quiet water or in riffles, of much larger pebbles, and placed in the open without regard to a sheltering stone or log. The temperature of the air was 22° C., that of the water 20.5° C. at 8:10 P.M.

There was another opportunity for more detailed observation on June 15, 1938, in Marvin Creek, one mile southwest of Smethport, McKean County, Pennsylvania. The stream was clear with alternating pools and riffles and with a flow of approximately 150 cubic feet per second. The width varied from 30 to 70 feet and the bottom consisted of sand, gravel and rubble. At 12 noon the air was 26° C. and the water 21° C. Five nests were found in a stretch of about one-fourth mile. These nests were all found in quiet water at a depth of from 12 to 18 inches. The distance from shore varied from 8 to 20 feet and the five nests were situated at the shore or upstream side of a large sheltering stone or boulder. Two occupied nests were within 10 feet of each other. Generally the nests were oblong in shape, the smaller diameter being 0.5 feet, the larger diameter 1.5 feet. Ripe males and females were collected in the immediate vicinity of the nests. The availability of shelter, as a large boulder or log, is a very important factor in the choice of a nesting place by both *Parexoglossum laurae and Exoglossum maxillingua.* One small nest was situated in the open with only a small stone for cover. However, no *Parexoglossum laurae* were seen near this nest and no eggs were recovered from among the pebbles.

A male stood guard at each nest attempting rather futilely to drive away various minnows, darters and crayfish that swarmed over the nest. Although the male would dart at and under them in an effort to keep them from the eggs they would retreat but a few feet and quickly return. The most persistent predators were young *Parexoglossum laurae, Notropis cornutus frontalis, Hyborhynchus notatus* and *Catonotus f. flabellaris.* When frightened at our approach the guarding male would quickly take shelter

under the nearby stone or log. Occasionally he would bring pebbles to the nest from a distance of 20 to 30 feet and on other occasions move pebbles from the periphery to the center of the nest. In this manner the first eggs laid eventually become covered to a considerable depth. Eggs were found at various depths in five of the nests. They were light yellow and 2 mm. in diameter. Larvae at various stages of development were found among the pebbles in one nest.—EDWARD C. RANEY, *Zoological Laboratory, Cornell University, Ithaca, New York.*

NOTES ON SOME MARINE FISHES FROM CONNECTICUT, WITH COMMENTS ON THE SCALES OF *ELOPS SAURUS*.[1]—During the summer of 1937, while the author was engaged in a study of the life history and habits of the striped bass (*Roccus saxatilis*) for the Connecticut State Board of Fisheries and Game and the U. S. Bureau of Fisheries, a number of interesting fishes were collected in the general region of Niantic, Connecticut. These specimens were either taken in haul seines while fishing for striped bass or in the traps of commercial fishermen in the vicinity.

With the possible exception of *Achirus fasciatus*, the species under consideration are distincly more common in the Middle and Southern Atlantic coastal states than they are in Connecticut waters. It seems probable that abnormally high temperatures in the summer of 1937 were responsible for the unusual variety of southern species so far north. During August, 1937, the water temperature reached a peak of 27.6°C. (81.7°F.) on the surface and 24.3°C. (75.7°F.) on the bottom (18 ft.) in the Niantic River, Connecticut, in an area that is strongly tidal, and close to the general localities of capture of the specimens in question. Moreover this condition of unusually high temperatures was maintained over a long period in August and September. It will be noticed from the list below that three of the four southern species concerned were captured during or shortly after this time, and also that more than one specimen of two of the species were taken. During the summer of 1936 the peak temperatures averaged 3.0°C. (5.4°F.) less than they did in 1937 in the same locality, and despite the fact that a larger number of seine hauls and more trips to the traps of commercial fishermen in this region were made none of the four southern species were encountered.

There follows a list of the unusual specimens taken in 1937.

Achirus fasciatus, the hogchoker or American sole.—Date of capture: September 8, 1937. Locality: Niantic River, Connecticut. Although this species is abundant to the south, it is not uncommon in Connecticut waters and was taken with great regularity in 1936 and 1937. This particular specimen is included in this list because of its record size. Bigelow and Welsh (1924, Fishes of the Gulf of Maine. Bull. U. S. Bur. Fish., 40, 1: 523) and other standard references for fishes of the Atlantic coast say that 6 or 7 inches is the maximum length. The present specimen was 21.2 cms. (8.3 inches) in standard length.

Rachycentron canadus, the cobia or sargent fish.—Date of capture: June 30, 1937. Locality: Niantic Bay, Connecticut. Standard length: 97.8 cms. (38.5 inches).

Decapterus punctatus, the round scad.—Several specimens were taken in August and September. One typical individual was captured on September 8, 1937, at the mouth of the Niantic River, Connecticut. It was 9.5 cms. (3.7 inches) in standard length, and its stomach contained several small crustacea.

Caranx hippos, the common jackfish.—Eleven specimens were taken from August to mid-October. One typical individual was captured on October 1, 1937, at the mouth of the Niantic River, Connecticut. It was 11.5 cms. (4.5 inches) in standard length.

Elops saurus, the ten-pounder.—Date of capture: October 29, 1937. Locality of capture: Bloody Point, Waterford, Connecticut. Standard length: 28.5 cms. (11.2 inches). This individual's stomach contained two small fish, probably *Menidia* sp.

Nichols and Breder (1927, Marine Fishes of New York and Southern New England. *Zoologica*, 9:33, 34) attempted to read the scales of thirteen specimens of *Elops saurus* taken in October and averaging 35 cms. in standard length. Their results "suggested that these fish were just entering on the second winter of their existence." Over fifty scales from all parts of the body of the specimen described above were examined closely, and no trace of annulus was observed at any time—see, for example, Fig. A, a photograph of a typical scale from the middle of the side of the body. It seems improbable

that an individual of this length (28.5 cms.) was a juvenile, and it is more likely that the annuli on scales from this species are often indistinct or completely lacking, thus making age determinations by this method alone subject to error.

The scales of *Elops saurus* show a wide variation in shape, general structure, and size (Figs. A, B, C, and D). A normal scale from the side of the body is seen in Fig. A, while the remaining three photographs show scales taken from the general region of the bases of the dorsal and anal fins, both of which are depressible into a sheath of scales. These sheaths are formed by a tremendous expansion of the exposed posterior part of the scales on either side of the fins concerned (Fig. B), the posterior saw-toothed margin of each overlapping the anterior portion of the next scale behind. Fig. C shows a scale from the second row making up the anal fin sheath, in which the exposed posterior portion is not so well developed. Fig. D shows two scales from the extreme anterior end of the dorsal fin from the first and second row below the series of scales making up the major part of the sheath. The scale with well developed radii shown in Fig. D is from the second row below the main sheath, and like that in Fig. C is a transitional form between the normal scales from the side of the body, which always have radii, and those making up the main part of the sheaths (the first row), which never have radii. The scales of *Elops saurus* are of added interest since it is difficult to know whether they are cycloid, as one would expect of such a primitive isospondylous fish, or ctenoid as in the majority of the acanthopterygians. It is well known that there are all sorts of intergradations between the true cycloid and ctenoid types, but these are most commonly found in orders of teleosts above the isospondyli. Certainly a scale from the side of the body of *Elops saurus* (Fig. A) gives every appearance of being ctenoid. The roughly rectangular shape of the scale, the distinct radii and somewhat crenulated anterior border, the arrangement of the circuli, and the serrated posterior margin are all general ctenoid characteristics. On the other hand, those scales without radii (Figs. B and D), if the exposed and much enlarged posterior parts be disregarded, appear far more like the cycloid type. If the distinction between cycloid and ctenoid scales ("edges entire" and "edges denticulated") given by C. Tate Regan (14th edition of the Encyclopædia Britannica) is taken, the scales of *Elops saurus* must certainly be ctenoid.

Breder (1929, Field Book of Marine Fishes of the Atlantic Coast from Labrador to Texas: 306) however, uses different criteria—"Cycloid: Said of scales that are smooth to the touch. This condition is due to their edges being entire and without spines. Ctenoid: Said of scales that are rough to the touch. This is due to their being minutely spinous." According to these definitions the scales of *Elops saurus* would be cycloid. This is so because the exposed posterior part of the scales is extremely thin and not "minutely spinous." It would seem that the word ctenoid as applied to scales cannot be defined in terms of the comb-like posterior margin of the scale. Instead, the presence of spinous projections or ctenii over the exposed posterior surface must be a deciding factor, although Koefoed (1910, Fishes from the Sea-Bottom. Report of the Scientific Results of the "Michael Sars" North Atlant. Deep-Sea Exped., 14, Pt. 1: 94) has described scales from macrurids as being cycloid despite the relatively large spines on the exposed parts, probably on the basis of the shape of the scales, lack of radii, and arrangement of the circuli.—DANIEL MERRIMAN, *Osborn Zoological Laboratory, Yale University, New Haven, Connecticut.*

THE GREAT WHITE SHARK, *CARCHARODON CARCHARIAS* (LINNAEUS), IN FLORIDA WATERS.—A 15½ foot specimen of this species was taken by Ferd Dalton and O. E. Holly of the Bass Biological Laboratory staff on one of the ordinary shark set-lines about 8 miles off Englewood, Florida, on February 1, 1939. The capture was accidental in that the shark had wrapped the main chain of the set-line around its tail before its struggles straightened the hook. The animal still had life when it was brought to the beach four days after capture. It is difficult to estimate the abundance of the great white shark because large individuals obviously cannot be taken on the kind of equipment now in general use. The stomach of this specimen contained two *Carcharinus milberti*, each between 6 and 7 feet long and both showing evidence of having been torn from hooks on the set-line. The digestion or decomposition of the stomach con-

[1] Published with the permission of the Superintendent of the Connecticut State Board of Fisheries and Game and the United States Commissioner of Fisheries.

Fig. A.

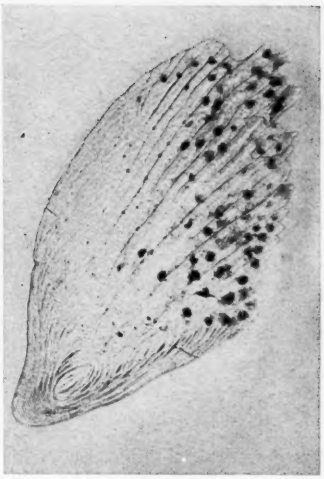

Fig. B.

Fig. C.

Fig. D.

Scales from a single specimen of *Elops saurus*, the ten-pounder. Magnification approximately x 17.5.

tent had not progressed far. The white shark was a female but embryos were not present. The ovaries were small and the oviducts were not well developed.

Although several species have been described for the genus *Carcharodon*, only one has been recognized by most recent authors and this species is generally regarded as having a cosmopolitan distribution in temperate and tropical seas. Probably there is not enough objective evidence available to support any opinion as to the number of existing species. It is unlikely that many specimens will be preserved, and unless fairly complete and accurate data are secured from those that do happen to fall into the hands of ichthyologists, it is probable that our knowledge of the most formidable of existing sharks will remain in its present unsatisfactory state.

Measurements covering the Englewood great white shark are given below. My experience with other sharks leads me to believe that a fairly accurate concept of a specimen can be obtained if measurements such as these are supplemented by notes describing any striking external feature as well as the shape of fins and color. If the dry jaws and a skin sample can be saved, the picture is fairly complete. Data in this form do not serve equally well for all groups of sharks and describe individual specimens rather than species, but it is often possible to find good specific characters from an analysis of a series of similar notations. The measurements here are made on the shortest surface line between two points unless some contrary method is specially indicated.

Total length	4700	mm.
Length exclusive of caudal fin	3800	
Tip of snout to—		
—front of mouth (length snout)	300	
—anterior margin of orbit	300	
—outer angle of nostril	200	
—first gill opening	1065	
—last gill opening	1315	
—base of pectoral	1315	
—anus	2690	
Horizontal diameter orbit	52	
Vertical diameter orbit	50	
Height first gill opening	425	
Height last gill opening	460	
Mouth, angle to angle (width mouth)	425	
Internasal	180	
Length mouth	235	
Length nasal aperture	65	
Snout to origin first dorsal	1780	
Anterior margin first dorsal	610	
Posterior margin first dorsal	120	
Distal margin first dorsal	520	
Base first dorsal	460	
Interdorsal	1025	
Anterior margin second dorsal	135	
Posterior margin second dorsal	90	
Distal margin second dorsal	90	
Base second dorsal	65	
Second dorsal to caudal	480	
Upper caudal lobe	950	
Lower caudal lobe	640	
Outer margin pectoral	900	
Inner margin pectoral	220	
Distal margin pectoral	790	
Base pectoral	340	
Outer margin ventral	270	
Anterior margin anal	125	
Posterior margin anal	100	
Base anal	65	
Vertical diameter caudal peduncle before pit	135	
Lateral diameter caudal peduncle before pit	315	
Largest tooth of upper jaw, height from enamel line	37	
Largest tooth of upper jaw, height from base	52	
Second dorsal in advance of anal	100	
Origin first dorsal behind inner posterior angle pectoral	35	

Spiracle 6 mm. greatest diameter, 200 mm. from orbit.

Tooth formula $\frac{13 + 13}{13 + 13 \text{ or } 14}$

This appears to be the second record of the species on the west coast of Florida, the other shark having been taken off Sarasota during the winter of 1937–1938. The Sarasota specimen was a female which I estimate from a photograph to have been approximately 15 feet long. It was taken on a set line made of a combination of steel cable and rope.—STEWART SPRINGER, *Bass Biological Laboratory, Englewood, Florida.*

REVIEWS AND COMMENTS

EINFÜHRUNG IN DIE VERGLEICHENDE BIOLOGISCHE ANATOMIE DER WIRBELTIERE. ERSTER BAND. By Hans Böker. Gustav Fischer, Jena, 1935: XI +228 pp., 225 text figs. R. M. 13.50 (with the 25% discount about $4.05).—"Comparative Biological Anatomy" proves to be a renewed attack on the problems of vertebrate anatomy, differing from the classical comparative anatomy and from descriptive anatomy in its emphasis, not only of function, but of the total environmental complex within which animals live. Comparative anatomy becomes an exciting field study, involving observation on museum expeditions as much as it does dissection in the laboratory. Böker observes behavior of an animal in its natural surroundings, observes, for example, the details of its locomotion, and formulates the problems for anatomical investigation of the structures involved from this viewpoint. This leads directly to a primary interest in *anology* instead of in *homology;* this is expressed in his "functional groups," i.e., series of functionally similar structures of varying degrees of development, either in allied forms or in animals of diverse origin. Phylogeny and ontogeny are drawn into consideration, and are often illuminated by Böker's functional comparisons.

Of all great biological problems, that of the origin of the detailed adjustment of organisms to the conditions of life set by their environment is one of the most complex, and at the same time, one of the most fundamental. The adaptations of animals excited the wonder and admiration of the pre-Darwinian students of natural history. Darwin and his fellow evolutionists were occupied with the search for a general valid explanation of the variety of structure in animals, its origin, and its relation to the environment. Modern biology, with a re-orientation in the important sciences of genetics, physiology, and ecology, is engaged in a new attack on the problem of adaptation. Research in comparative anatomy in American universities has declined for a generation with the general decline of interest in systematic zoology in favor of the more experimental disciplines. The rise of modern ecology emphasizes some of the resulting weaknesses of the systematic literature, and necessitates a revaluation of taxonomic research, since it is found that sound and comprehensive systematic reviews are a necessary foundation for most ecological studies. Morphology, like systematic zoology, was abandoned too soon in university laboratories. Comprehensive accounts of the anatomy of only the barest minority of the important types of vertebrates are available. Just as the formulation of natural history into the more critical ecology may be expected to stimulate renewed systematic studies, descriptive anatomy will attract renewed interest from the development of a "biological comparative anatomy."

Böker's work orients comparative anatomy to this same problem of adaptation. He proposes, briefly, to turn from the search of the classical comparative anatomists for homology and arch-type to the study of anatomical analogy and to illuminate this study by constant reference to function, and hence to mode of life and relation with the natural environment. All this is far from being a wholly new attack on the relation of form and function; but in its change of emphasis, in carrying the concept of adaptation into the principal anatomical structures, and especially in emphasizing the importance of re-adaptation of structure in association with changing environment, Professor Böker does open up new problems and prepare the way for a fresh attack on old ones. This means that the anatomist of the future must be a field naturalist like his colleagues, the taxonomists, and every step taken toward better understanding of the detailed working of animal structures and physiological systems is a step in the direction of cooperation with the systematic zoologists on one hand and the ecologists on the other.

In a general introduction entitled "Problems and Methods of Comparative Biological Morphology" the aim of the work is explained and some of the more general terms defined. Much of this section, with its orientation of anatomical studies to detailed observation of the living creature, and above all, to observation in its native environment,

is admirable. The concluding part of this introduction, emphasizing the importance of biological comparative anatomy in the study of human illness, and hence its place in medical education, is unintelligible.

Since much of Böker's argument includes phylogenetic speculation, a further section, also introductory to the work as a whole, sets forth his ideas of the origins of the major groups of vertebrates under the title of "Morphological Typology" (subtitled "the biological anatomy of primitive types"). While one may sympathize with the desire to visualize a series of hypothetical ancestral types with the full admission of their hypothetical nature, it will seem to American readers that Böker has been unnecessarily original.

The main section of the first volume deals with the biological anatomy of locomotion. It begins with the section on climbing, analysing and classifying the various kinds of climbing, and introduces some concepts new at least to the reviewer. The thirty-two page section devoted to climbing is followed by thirty-four pages on flight, an equal space is devoted to walking and running, twenty-two pages deal with digging and burrowing, and the thirty-page section on swimming closes the volume. This seems to the reviewer an arbitrary and unnatural order for a treatment of the locomotion of the vertebrates; but the analysis under each principal type of locomotion is often excellent, and stimulating even when it fails to convince. The section on walking is surprisingly the weakest; Böker admits no walkers among the amphibians, and fails to discuss this fundamental mode of locomotion in reptiles.

In the more strictly herpetological sections the author falls into a considerable number of errors and misinterpretations. The reviewer does not agree to Böker's derivation of snakes (and their mode of locomotion) from burrowing forms; his treatment of the climbing of the elongate tree snakes misses the importance of the I-beam principle of their compressed bodies, and repeats the idea that their vertebral columns cannot be bent upward in a vertical plane. The origin of turtles is dealt with somewhat summarily as due to the necessity for working through thick brush, the "bush breaking" theory, of which we are promised a more detailed account in a future volume. This seems to the reviewer to be sheer nonsense.

If the section dealing with vertebrate locomotion is paged through for a survey of its illustration, it will be found both interesting and suggestive. It is consequently the more disappointing to find the execution in detail, the author's knowledge of paleontological literature, and his critical judgment alike inadequate for a successful development of his plan. Thus in his useful contrast of "grasping climbing" and "hanging climbing," he misses the important works of Straus and Wislocki and of André Forster and misinterprets the structures in the potto as an example of grasping climbing. In deriving mammals from amphibians, he seems actually to return to the primitive classification in which the reptiles and birds were bracketed against the amphibians and mammals. He attempts to derive the tree sloths from ant-eating ancestors instead of from the extinct ground sloths. Too great faith that all structures must be adaptive pervades the work. The whole tenor is Lamarckian, use being cited as directly causal in adaptation and readaptation; the vitally important newer viewpoints of genetics, which restore natural selection very much to its pre-Mendelian importance in evolution, and specifically in the evolution of adjustment to the environment, are missed.

Thus it is felt by the reviewer that the whole work requires detailed scrutiny; but this very fact makes it important to any serious student of anatomy, and the very effort to formulate a criticism or refutation of Böker's statements and interpretations cannot fail to clarify topic after topic in the mechanics of locomotion.

The importance of the work lies primarily in its direction of attention to the observation of living animals with notebook in hand. All animal adaptations need to be scrutinized to see exactly how they function or how they are operated. Even the simplest aquarium and terrarium equipment, with Böker's questions in mind, affords opportunities for genuinely scientific observation; and renewed attention is directed to the neglected opportunities for observation in zoological gardens. The field naturalist in the tropics will spend less time in collecting and more in observation and note-taking.—Karl P. Schmidt, *Field Museum of Natural History, Chicago, Illinois.*

A NEW CATALOGUE OF THE FRESH-WATER FISHES OF PANAMA. By Samuel F. Hildebrand. Field Museum of Natural History, Zoological Series, 21 (4), Sept. 28, 1938: 217-359, figs. 2-13.—Dr. Hildebrand has done the many zoologists interested in the Panamanian fauna a distinct service in preparing this supplement, which brings up to date the 1916 monograph by himself and the late Dr. Meek. Although surprisingly little has been done on the fluviatile fish fauna of Panama since 1916, the collections of Breder and Behre in opposite ends of the republic have added many species to the fauna, and considerable revisional work touching Panama fishes only incidentally has necessitated a number of systematic changes. A large proportion of these is included in the present review, in addition to the results of Dr. Hildebrand's own recent field work. It must be noted, however, that those portions of Veragua between the Canal Zone and Chiriqui, as well as much of eastern Panama, still form a veritable *terra incognita* to the ichthyologist.

Several systematic comments seem necessary. The generic name *Plecostomus* (p. 237) must unfortunately be superseded by *Hypostomus*. The description of a new *Gephyrocharax* (p. 254) shows no adequate comparison with South American forms. Dr. Hildebrand's quotations from Eigenmann in regard to the ranges of the two forms of *Piabucina* (p. 288) show that he has overlooked Myer's paper on this subject (COPEIA (166), 1928: 4). The generic name *Sternarchus* must give way to *Apteronotus* (p. 292). The author's statement that *Synbranchus marmoratus* stands alone in its family "with no near relatives so far as known" is peculiar in view of the close relationship of the American form with African and Indian species. (A new blind genus from Yucatan has recently been announced.) The name of the common American eel (p. 294) has been shown to be *Anguilla bostoniensis*, under the "rule of the first reviser". It is unfortunate that Dr. Hildebrand did not have access to Dr. Behre's cichlid material. Some of it is certainly misidentified, notably her *"Cichlasoma nigrofasciatum"*, which seems to be Regan's *C. septemfasciatum*. *Eulepteleotris*, a supposed new genus based on two new species, one from the Atlantic and one from the Pacific slope, is identical with *Erotelis* (synonym *Alexurus*).

Of all sections of the report, Dr. Hildebrand's treatment of the classification of the viviparous poeciliids is most likely to be criticized adversely. His attitude in not accepting many recent refinements in the classification of the poeciliids is a tendency still reflected in the writings of a few ichthyologists who have not yet realized the extraordinary differentiating characters that exist in the internal anatomy as well as in the gonopodium and mouth structures of these remarkable little fishes. In view of Hubbs's determination of the Gatun Lake *Gambusia* as an introduced northern form (*Gambusia affinis speciosa*), Dr. Hildebrand's defense of his identification of the fish as *G. nicaraguensis* is interesting. But, aside from gonopodial differences, the Gatun *Gambusia* does not have the deep body characteristic of *nicaraguensis*, and it may be remarked that small mosquito-eating and aquarium poeciliids have been introduced into many tropical countries without records having been kept. Concerning Dr. Hildebrand's comments on the distribution of *Brachyraphis episcopi* it may be said that experience with this species at Barro Colorado would indicate that it is a stream rather than a lake fish. It is common in a little trickle a few yards down the hill from the laboratory buildings.—REVIEW COMMITTEE.

THE SPRAT AND THE SPRAT FISHERY OF ENGLAND. By J. Armitage Robertson. Fishery Investigations, Ministry of Agriculture and Fisheries, Ser. II, 16 (2), 1938: 1-100, 15 figs. 4s. 6d.—This paper deals with the statistics of the sprat fishery and with the life history of the species. The distribution, age, rate of growth, mortality, spawning, development, food, and diseases are considered in more or less detail, the literature reviewed and much new material presented. As is true of many fisheries investigations, much of the study on age and rate of growth depends on scale readings. Hence one would have liked to see in the present work a fuller discussion of this technique, and demonstration that the marks counted on the scales to determine age are really annual in origin. That different people may succeed in counting the same number of marks is not necessarily proof that the latter do indeed indicate age.—L. A. WALFORD, *Jordan Hall, Stanford University, California.*

MARINE FISHES OF THE PACIFIC COAST OF MEXICO. Edited by Tosio Kumada. Text by Yosio Hiyama. The Nissan Fisheries Institute & Co., Ltd., Odawara, Japan, 1937: 75 pp., 102 plates, 42 colored. $25.00.—At the invitation of the Mexican government, in 1936, The Nissan Fisheries Institute of Japan sent the trawler "Minato-maru" for a voyage of experimental fishing along the west coast of Mexico. Since the trawl net was the only gear used, the species caught were with few exceptions bottom living forms. Of these, 122 species were selected as "representative" to be described and figured in the book under review. Specimens were frozen, sent to the Nissan Institute, where they were thawed slowly, photographed and painted. In this connection, the authors appropriately say, "As far as possible the natural colours have been reproduced, however as the coloration of fish reappeared after melting the frozen sample, inclined to fade away somewhat, except black or brown, so the colorations are revised by our experience." The results have a quality typically Japanese. The drawings are excellent, so that those species unidentified by the authors, or those mis-identified, can be easily recognized from them. Essentially, the book is a collection of illustrations, the descriptions being reduced to the barest minimum. There are keys for some of the families, which refer only to those species described. Hence, identification hinges chiefly on the pictures. One of the most interesting records in the book is that of *Dixonina nemoptera*, figured as "*Albula vulpes*" from the Gulf of California. Apparently several were caught, the third record, so far as I know, since the type speciman.—L. A. WALFORD, *Jordan Hall, Stanford University, California.*

TROUT STREAMS. By Paul Needham. Comstock Publishing Company, Ithaca, New York, 1938: i-x, 1-226, 74 figs. $3.00.—This small book covers its very large field—the ecology and management of trout streams—in a remarkably comprehensive way. Though of necessity brief, it is more than an introductory text, it is a handbook and guide to workers in fresh water fisheries biology. Though written in a "popular" style, the book has a high degree of accuracy and proper critical attitude towards the various conservation practices discussed. The book is somewhat over-balanced on the subject of food organisms, but this is not a serious fault. The chapter headings are as follows: I Trout and Salmon, II Stream conditions, physical and chemical, III Trout stream animals, IV Food selection by trout, V Distribution of trout foods, VI Propagation, stocking and protection, VII Stream and lake management. An appendix gives further information on the following: names of trout, instructions for collecting fish scales, planting table for streams and lakes, organization of stream and lake survey crews, methods of locating unnamed waters and waters bearing duplicate names, and blank forms for use of survey crews. A well-selected bibliography and an index are included.—REVIEW COMMITTEE.

NEW BOOKS RECEIVED

THE SOCIAL LIFE OF ANIMALS. By W. C. Allee. W. W. Norton & Co., New York, 1938: 1-287, 49 figs. $3.00.

CONSERVATION IN THE UNITED STATES. By A. F. Gustafson and others. Comstock Publishing Co., Ithaca, N.Y., 1939: 1-431, 232 figs. $3.00.

THE FISH OF THE GEORGE VANDERBILT SOUTH PACIFIC EXPEDITION, 1937. By Henry W. Fowler. Acad. Nat. Sci. Philad., Monographs No. 2, 1938: i-v, 1-305, 31 figs.

SELECTED LIST OF BIBLIOGRAPHIES OF THE POLAR REGIONS, PART I. Published under sponsorship of the Explorers Club and compiled and edited by a staff supplied by the United States Works Progress Administration for the city of New York, 1938: 41 pp., mimeographed, 450 entries.—Compiled from books and serial publications of the past 30 years.

REPTILES AND AMPHIBIANS. Prepared by Federal Writer's Project of the Works Progress Administration of New York City. Albert Whitman and Co., Chicago; XII + 253, illustrated. $2.25.

WHAT SNAKE IS THAT? A Field Guide to the Snakes of the United States East of the Rocky Mountains. By Roger Conant and William Bridges. Appleton-Century, 1939: VIII + 163, illustrated. $2.00.

A CHECK LIST OF NORTH AMERICAN AMPHIBIANS AND REPTILES. By Leonhard Stejneger and Thomas Barbour. Harvard University Press, Fourth Edition, 1939: XVI + 207. Bound $4.00, unbound $3.50.

EDITORIAL NOTES AND NEWS

Annual Meeting

FIELD MUSEUM, the SHEDD AQUARIUM, and the CHICAGO ACADEMY OF SCIENCES will be host to the AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS for the 1939 meetings, to be held September 13 to 16 in Chicago. The plans call for meetings at the Field Museum, the Academy of Sciences, and the Shedd Aquarium. The evening smoker (Thursday the 14th), will be held at the Aquarium. DR. ANTON J. CARLSON has consented to speak at the Annual Dinner (Friday the 15th). Entertainment is being planned for ladies who may not wish to attend technical sessions.

The meetings are to include a symposium on speciation, and one on problems in Mexican biology. It is hoped that a full and varied program of general papers may be offered. It is a pleasure to announce two prizes offered by F. H. STOYE, of $10.00 each, for the best paper by a member of the Society not professionally employed. It is hoped that our younger members may be stimulated to active participation in the program.

The members of the Local Committee are KARL P. SCHMIDT, Chairman, WALTER H. CHUTE, HOWARD K. GLOYD, WALTER L. NECKER, C. L. TURNER, A. C. WEED and FLOYD YOUNG.

Western Meetings

THE men directly responsible for the fish-ways and fish-conservation measures at the Bonneville, Grand Coulee, and Shasta dams participated in the very important and timely symposium "Dams and the Problem of Migratory Fishes," presented jointly by the Western Division, ASIH, and the Western Society of Naturalists at the Pacific Division Meetings of the American Association for the Advancement of Science at Stanford University, California, June 26 to July 1, 1939.

The five invited speakers were: DR. WILLIS H. RICH, Stanford University, director of research for the Fish Commission of Oregon, and internationally known specialist on the migration of the Pacific salmon, who introduced the subject and pointed out its ramifications; DR. HARLAN B. HOLMES, U.S. Engineer's Corps, who was in charge of the planning and execution of the fish-ways at Bonneville Dam; DR WILBUR M. CHAPMAN, University of Washington, in charge of migratory fish investigations relative to the Grand Coulee Dam; MR. HARRY HANSON, U. S. Bureau of Fisheries, now conducting investigations relative to the effect of the new Shasta Dam upon salmon and trout; and MR. ALAN C. TAFT, Chief of the Bureau of Fish Conservation, California Division of Fish and Game, who summarized the situation and pointed out the implications in California.

The SIXTH PACIFIC SCIENCE CONGRESS will be held at the University of California, Stanford University, and in San Francisco, California, July 24 to August 12, 1939, under the auspices of the NATIONAL RESEARCH COUNCIL. A wide variety of symposia will be presented, under eight general sections, (1) The Pacific Basin and its Geology; (2) Oceanography, including Fisheries and Marine Biology; (3) Pacific Climates, past and present, including Meteorology; (4) Man and Culture in the Pacific Region; (5) Terrestrial Fauna of the Pacific Islands and Bordering Regions; (6) Terrestrial Flora of the Pacific Islands and Bordering Regions; (7) Public Health and Nutrition; and (8) Soil Problems.

The AMERICAN SOCIETY OF ICHTHYOLOGISTS AND HERPETOLOGISTS is cooperating fully with the Congress, not only as an organization through its National body and its Western Division, but also through the efforts of many individuals. Several divisions of sections listed above are in charge of ASIH members, while many others are contributing important papers. For the Society's Western Division, President F. B. SUMNER has appointed the following to serve as representatives at the Congress: DR. GEORGE S. MYERS, of Stanford University (Chairman), DR. CHARLES L. CAMP, of the University of California, MR. H. WALTON CLARK, of the California Academy of Sciences, and MISS MARGARET STOREY, of Stanford University. PRESIDENT L. M. KLAUBER has asked the same group,

with the addition of DR. SUMNER, of the Scripps Institution of Oceanography, and DR. GEORGE MYERS, of Stanford University, to represent the national ASIH at the Congress.

The New Checklist

THE 4th edition of the *North American Checklist of Reptiles and Amphibians* is now on sale at the Harvard University Press, Cambridge, Massachusetts. Bound copies cost $4.00 each. In response to numerous requests, a number of copies have been held unbound in sheets for those who wish to bind them themselves or to have copies interleaved. These will be $3.50 each. Every effort has been made to have this new edition complete up to January 1, 1939. It is printed on a different paper from the others, and it is believed that this new format will make notations in ink more legible. Herpetologists who have incomplete sets of this indispensable work will be pleased to learn that a limited number of copies of some of the earlier editions are still available at the publishers.

Notes News

UNDER the auspices of the SEARS FOUNDATION FOR MARINE RESEARCH, a comprehensive revision of the fishes of the western Atlantic is to be undertaken. In addition to the usual synonymies, descriptions, figures, etc., the work is to include brief summaries of what is known of the life history and habits of the fish discussed. The Editorial Board consists of C. M. BREDER, S. F. HILDEBRAND, J. R. NORMAN, A. E. PARR, W. C. SCHROEDER, H. SEARS, and J. TEE VAN; and an Advisory Committee includes W. BEEBE, C. L. HUBBS, G. S. MYERS, J. T. NICHOLS, and L. P. SCHULTZ. J. TEE VAN is Chief Editor. Ichthyologists throughout the country will collaborate by contributing sections of the work. Contributors will be asked to produce *new* work with careful thought to make the text as accurate and as modern in treatment and concept as possible. An outline guide has been prepared to assure uniformity of arrangement and style. The geographical scope of the work will be the western North Atlantic with adjoining gulfs and seas, from Hudson Bay southward to the mouth of the Amazon, including the West Indies and Bermuda. Pelagic forms will be included but the strictly deep sea, bathypelagic forms will be omitted. Issuance of the "Fishes of the Western North Atlantic" will be in the order of one volume a year. The finished work will probably be three to five volumes long. It is hoped that printing of the first volume will begin in 1941.

DR. L. P. SCHULTZ of the United States National Museum is leaving aboard a United States naval vessel for several months' collecting in the Pacific.

DR. E. LIEBMANN, formerly head of the Marine Laboratory in Heifa (Palestine), now resides at 420 North Soto Street, Los Angeles. Dr. Liebmann, who was engaged in investigations along the eastern Mediterranean coast and who has also studied the biology of fresh water fish, is seeking a position in this country.

J. A. TUBB, assistant research officer, Fisheries Section, Council for Scientific and Industrial Research of Australia, has recently spent several months visiting fishery research institutions along the Pacific coast. Mr. Tubb is the second of three Australian research students to visit the west coast of the United States for the purpose of studying fisheries research methods and organization.

THE FISHERIES SECTION of the Council for Scientific and Industrial Research of Australia has been re-organized under the directorship of DR. HAROLD THOMPSON, late of Newfoundland, to commence an intensive program of research in Australian fisheries. Their laboratory is situated at Cronulla, near Sydney, New South Wales. The vessel *Warren*, built as a purse seiner with laboratory space on deck, has been in commission for several months, working along the eastern coasts of Australia and Tasmania.

In March, DR. W. E. RICKER left the scientific staff of the International Pacific Salmon Fisheries Commission to accept a position as assistant professor in the Department of Zoology of the University of Indiana. Dr. Ricker was stationed for a number of years at Cultus Lake while working on sockeye salmon, especially the food of the young and the effect of predators. He was also engaged in limnological and plankton studies of Cultus Lake.

KARL P. SCHMIDT will engage in field work for Field Museum of Natural History in southern Peru, Bolivia, and Chile in the course of the museum's "Magellanic Expedition." He sailed from New York with C. C. SANBORN and JOHN M. SCHMIDT on July 7.

DR. ROLF L. BOLIN of the Hopkins Marine Station of Stanford University has recently returned after accompanying the new California State Research vessel *N. B. Scofield* on a cruise off the west coast of Central America. A large collection of fish was obtained.

DR. EDWARD STUART RUSSELL, Director of Research, Ministry of Agriculture and Fisheries, Great Britain, visited the United States during March to deliver the De Lamar lectures in hygiene before the School of Hygiene and Public Health of Johns Hopkins University, Baltimore, Maryland, during the week of March 20. The subject of the five public lectures was "Fish Populations and the Effect of Fishing." Dr. Russell, who is a distinguished student of the broader aspects of biology, has long been engaged in fishery investigations in England. He is probably best known to American readers as editor of the *Journal du Conseil,* published by the Permanent International Council for the Exploration of the Sea.

DR. MYRON GORDON has recently returned from Mexico, where he studied and collected fishes on a Guggenheim Fellowship in connection with his genetic studies and with the faunal studies being carried on in Michigan.

DR. C. L. TURNER, of the Department of Zoology of Northwestern University, has leave of absence for the second half of this year. He will continue his studies on adaptations to viviparity in fishes, and will travel and collect mostly in the Pacific drainage.

According to *Science,* DR. H. W. NORRIS, of Grinnell College, is spending a few months at the Bass Biological Laboratory in Englewood, Florida. He is engaged in further work on the pituitary bodies of sharks and rays.

JOHN D. BLACK, of the Zoology Department of the University of Arkansas, has been granted a renewal of the Julius Rosenwald Fellowship, under which he had undertaken at the Museum of Zoology, University of Michigan, a distributional study of the fishes of Arkansas.

DAVID H. WALLACE, fishery biologist of the Chesapeake Biological Laboratory, is continuing Dr. Vladykov's life-history studies of the striped bass and is giving attention also to the life history of *Micropogon undulatus.*

The degree of Doctor of Science has been awarded by the University of Newark to C. M. BREDER, JR., of the New York Aquarium, in recognition of his researches on fish biology.

DR. REEVE M. BAILEY has joined the staff of the Zoology Department of Iowa State College, Ames, Iowa, as an instructor.

Recent Deaths

NEWS has been received from Dr. Willy Wolterstorff of the death on February 28 of PROF. FRANZ WERNER, aged 71. Prof. Werner was an able educator: he taught in the Zoological Institut of Vienna from 1895 to 1933, when he became emeritus. He was an ardent field naturalist and a gifted and versatile investigator, as shown by his lengthy list of publications, which include papers on scorpions and Orthoptera in addition to the many herpetological items. In 1936, Prof. Werner was elected an Honorary Foreign Member of the Society in recognition of his valuable contributions to our knowledge of herpetology.

DR. WILLIAM CONVERSE KENDALL, formerly senior ichthyologist of the United States Bureau of Fisheries, died on January 28, 1939, at Mobile, Alabama. Dr. Kendall graduated from Bowdoin College in his native State of Maine in 1885 and a few years later received the degree of Doctor of Medicine from Georgetown University, Washington, D. C. On the fiftieth anniversary of his graduation, Bowdoin College again honored him with the degree of Doctor of Science. On February 4, 1889, Dr. Kendall entered the service of the Bureau of Fisheries and, except for the period from October, 1921, to July, 1923, served continuously on the scientific staff of the Bureau until his retirement on June 30, 1932. Dr. Kendall achieved distinction as one of the most eminent of American ichthyologists and as world authority on salmon and trout. His investigations as naturalist on the Bureau of Fisheries schooner *Grampus* and on the steamer *Fish Hawk* along the Atlantic and Gulf coasts of the United States included a wide range of scientific projects. During the few years that he was employed as a member of the staff of the Roosevelt Wild Life Forest Experiment Station in New York, he carried on investigations on fresh-water fishes other than the trouts and salmons. In the latter

field, however, he was pre-eminent, making important contributions to scientific fisheries literature as well as practical ones in the field of fish culture. In his later years Dr. Kendall also made expeditions to the Arctic Region, to Greenland under the auspices of the National Geographic Society, and later to Baffin Land to collect fishes from these remote regions. On his retirement from the Bureau of Fisheries, Dr. Kendall returned to his birthplace of Freeport, Maine, but he has since traveled widely in the United States. It was on a trip to the South for the winter that his final illness overtook him at a hospital in Mobile, Ala., where he died at the age of 78. He is survived by a daughter, Mrs. Harrison Warner.

Dr. Arthur Paul Jacot, who published contributions on the life history and systematics of mullets, and on many other biological subjects, died on March 24, at the age of 49.

The death of Dr. George C. Embody, Dean of American fish culturists, at Daytona Beach, Florida, on February 17, means the loss of one of the most distinguished and productive biologists of our time. Paul Needham, in the *Progressive Fish Culturist* (March-April, 1939) says of him: "Dr. Embody was born in Auburn, New York, November 23, 1876. He attended Colgate College, graduating with a Bachelor's Degree in 1900 and receiving his Master's Degree in 1901. For his leadership and accomplishments in his chosen field, Colgate awarded him an honorary Doctor of Science Degree in 1924. He pursued his graduate work at Johns Hopkins University in 1906 and 1907, and took his Doctorate at Cornell University in 1910, after several years of teaching. In the fall of 1911 he started teaching aquiculture at Cornell, where he remained until the time of his death. Although originally intending to be a physicist, his love of nature, especially of field work, and of both fishing and hunting, led him into the then unsounded field of fisheries management. His contributions for the improvement of practical hatchery technique and planting procedures were the first to be developed. His paper, "An Outline of Stream Study and the Development of a Stocking Policy," published in 1927, originated the first planting table and other data on trout showing the numbers of fish that should be planted in relation to food, shelter, and other stream conditions. He made the first stream survey in Tompkins County, New York, in 1918 and 1919 which was later published by the New York State Conservation Department in 1922.

"Dr. Embody's paper on trout feeding experiments in the December, 1918, issue of the *Transactions of The American Fisheries Society* was awarded first place for original work in fish culture. In 1924 he served as president of this Society.

"He started the first strictly experimental fish hatchery, on Cascadilla Creek on the Cornell Campus, where he developed many of the modern fish-cultural practices. The New York Biological Survey Reports, the first of their kind in America, were initiated in 1926 largely through Dr. Embody's efforts in close cooperation with Dr. Emmeline Moore. His work in improving hatchery technique and methods used in New York State more than tripled production and greatly reduced costs over the period of years he worked with the Conservation Department. New York and New Jersey Conservation Departments consulted him repeatedly; other states sought his advice; commercial and private hatcheries confronted him with their problems; tropical fish enthusiasts and sport fishermen received his advice; in short, his advice was always available regardless of station.

"Dr. Embody had two books about ready for publication when he died: a manual of goldfish culture and one on general fish culture, with special reference to trout. His son, Daniel R. Embody, plans to complete these and certain other manuscripts. . . .

"Dr. Embody will be remembered as much for his personal qualities as for his contributions to fisheries science. As a friend and counsellor, as well as a teacher, he inspired students with confidence and enthusiasm. His serenity of spirit under all conditions and difficulties was amazing to those of us who had the privilege of working under him. To many, his passing is more that of a close personal friend. In all his relationships with people, there was nothing but praise for him. His funeral at Sage Chapel on the Cornell Campus in Ithaca exemplified his wide range of friendships. The chapel was filled with persons in all walks of life who had come to mourn his passing and to honor him."

DR. YOJIRO WAKIYA, one of the most productive of Japanese ichthyologists, was killed by an electric car near Tokyo on April 21, at the age of 67. He was known particularly for his studies of the Carangidae, Salangidae and Salmonidae of the Japanese empire, but also published investigations on many other groups of fishes, and on oysters. For many years he was director of the fisheries institute at Fusan, Chôsen, which he developed into a leading center of ichthyological and fisheries research. Dr. Wakiya was particularly kind and helpful to his colleagues, including Dr. David Starr Jordan and other American ichthyologists.

DOUGLAS D. H. MARCH, Curator of the Old Panama Zoological Garden, died of snake bite on April 3, at the age of 52 years.

DR. HENRY VAN PETERS WILSON, Professor of Zoology at the University of North Carolina, died on January 4 in his 76th year. Dr. Wilson was largely instrumental in establishing and developing the present biological laboratory of the United States Bureau of Fisheries at Beaufort, North Carolina. He was widely known to ichthyologists for his excellent treatise on the embryology of the black sea bass, and to biologists in general for his studies on the morphology, reproduction and growth of marine animals.

We regret to learn of the recent deaths of the well-known Brazilian ichthyologist and herpetologist, ALIPIO DE MIRANDA RIBEIRO, of the Museum National in Rio de Janeiro, and of DR. JOSEPH GRINNELL, Director of the Museum of Vertebrate Zoology, University of California. Fuller notices will appear in a later issue.

A Living Coelacanth Fish

THE astounding announcement of the discovery of a living coelacanth crossopterygian fish off the South African coast last December is of the utmost interest to ichthyologists (J. L. B. SMITH, *Nature*, 143, Mar. 18, 1939: 455–456, fig.; E. I. White, *Illustrated London News*, March 11: supplement; see also notices in *Time*, April 3: 35, and *Life*, April 3: 26–27). The single specimen is reported to be five feet long and to have weighed 127 pounds. It was obtained by a trawler in 40 fathoms, off East London, and is said to have lived for three hours on deck after its capture. Unfortunately, the fish had been skinned and mounted before the arrival of Dr. J. L. B. Smith of Rhodes University College, Grahamstown, who had been asked to examine it, but the skull, part of the pectoral girdle, and the end of the vertebral column are still intact in the mounted specimen. The photos accompanying the above-mentioned references leave no doubt that this fish is actually a coelacanth, rather closely resembling *Undina* of the Upper Jurassic, but with paired fins better developed and more limb-like. Dr. Smith has named the creature *Latimeria chalumnae*.

Since *Polypterus* has been shown to be more like the paleoniscids than the crossopterygians, the new fish provides us with the first living member of the general group from which the amphibians and higher vertebrates are now held to have evolved. It is, moreover, the first really archaic living teleostome from salt water. That there is some hope of securing more material is shown by the report of a person having seen a similar specimen cast ashore on a South African beach some time ago. We await with intense interest Dr. Smith's full description of what is in many ways the most remarkable ichthyological discovery ever made.—G. S. MYERS.

Announcements

HERPETOLOGISTS desiring copies of the late CARLOS GOFF's papers on "Distribution and Variation of a New Subspecies of Water Snake, *Natrix cyclopion floridana*, with a Discussion of its Relationships," "Melanism in *Lepisosteus osseus*," and "Egg Laying of *Pseudemys floridana*," may secure them from COLEMAN J. GOIN, Department of Zoology, University of Florida, Gainesville.

DR. CARL L. HUBBS, Museum of Zoology, Ann Arbor, Michigan, has available for distribution duplicate copies of "A Preliminary Report on a Fish Cultural Policy for the Palisades Interstate Park," by T. L. Hankinson, and "Notes on Life-histories of Illinois Fish," by Charles C. Adams, T. L. Hankinson, and W. C. Kendall, and a limited number of reprints of other papers by the late Prof. T. L. Hankinson.

Correction

IN the article "Notes on the Life History of the Tidepool Johnny *(Oligocottus maculosus)*" Copeia (1), 1939, the generic name on page 23, line 2, should be *Oligocottus* instead of *Oligottus* as spelled.

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